NAVAL POSTGRADUATE SCHOOL
MONTEREY, CALIFORNIA

THESIS

DIRECT BROADCAST TECHNOLOGY IN BOSNIA: ITS IMPACT ON THE DECISION MAKING PROCESS AND JOINT ENDEAVOR OPERATIONS

by

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June, 1997

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DTIC QUALITY INSPECTED 3

19980113 019

REPORT DOCUMENTATION PAGE

Form Approved OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instruction, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188) Washington DC 20503.

1. AGENCY USE ONLY *(Leave blank)*	2. REPORT DATE June 1997	3. REPORT TYPE AND DATES COVERED Master's Thesis

4. DIRECT BROADCAST TECHNOLOGY IN BOSNIA: ITS IMPACT ON THE DECISION MAKING PROCESS AND JOINT ENDEAVOR OPERATIONS	5. FUNDING NUMBERS
6. AUTHOR(S) Robert D. Morrill	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Naval Postgraduate School Monterey CA 93943-5000	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) USAF INSS, HQ USAFA/DFES, 2354 Fairchild Dr., Ste. 5D33, USAF Academy, CO 80840	10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES The views expressed in this thesis are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government.

12a. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution is unlimited.	12b. DISTRIBUTION CODE

13. ABSTRACT *(maximum 200 words)*

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A precursor to GBS, the Joint Broadcast Service (JBS), was begun as an Advanced Concept Technology Demonstration (ACTD). It is now leveraging DBS technology to support Operation JOINT ENDEAVOR. This thesis describes how the JBS works, what types of information are sent over the JBS, the complete process of information distribution, and the impact the JBS has had on Operation JOINT ENDEAVOR and the associated operational decision making process.

The JBS system has, at least in part, answered the joint warfighter's need for an improved high-bandwidth video and data distribution system. Although it does have force enhancement capabilities, the lack of familiarity, information management, and trust of the system have limited its effectiveness in Operation JOINT ENDEAVOR.

14. SUBJECT TERMS Direct Broadcast Technology, Global Broadcast Service, Joint Broadcast Service, DBS, GBS, JBS, Bosnia, Operation JOINT ENDEAVOR, Satellite Communications	15. NUMBER OF PAGES *116
	16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT Unclassified	18. SECURITY CLASSIFICATION OF THIS PAGE Unclassified	19. SECURITY CLASSIFICATION OF ABSTRACT Unclassified	20. LIMITATION OF ABSTRACT UL

NSN 7540-01-280-5500 Standard Form 298 (Rev. 2-89)

Prescribed by ANSI Std. 239-18 298-102

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DIRECT BROADCAST TECHNOLOGY IN BOSNIA: ITS IMPACT ON THE DECISION MAKING PROCESS AND JOINT ENDEAVOR OPERATIONS

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Submitted in partial fulfillment
of the requirements for the degree of

MASTER OF SCIENCE IN SYSTEMS TECHNOLOGY
[Command, Control, and Communications (C3)]

from the

NAVAL POSTGRADUATE SCHOOL
June 1997

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DTIC QUALITY INSPECTED 3

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LIST OF ACRONYMS AND/OR ABBREVIATIONS

1AD	1st Armored Division
ABCCC	Airborne Battlefield Command and Control Center
ACC	Air Combat Command
ACTD	Advanced Concept Technology Demonstration
AFC4A	Air Force C4 Agency
AFGWC	Air Force Global Weather Central
AFRTS	Armed Forces Radio and Television Service
AFSPC	Air Force Space Command
AKA	also known as
AO	Area of Operation
AOC	Air Operations Center
AOR	Area of Responsibility
ARPA	Advanced Research Projects Agency
ARRC	Allied Rapid Reaction Corps
ATO	Air Tasking Order
ATM	Asynchronous Transfer Mode
BC2A	Bosnia Command and Control Augmentation Initiative
BDA	Battle Damage Assessment
BITF	Battlefield Information Task Force
BLOS	Beyond-Line-of-Sight
BMC	Broadcast Management Center
C2	Command and Control
C2I	Command, Control, and Intelligence
C4I	Command, Control, Communications, Computers, and Intelligence
C4ISR	C4I Surveillance and Reconnaissance
CAOC	Combined Air Operations Center
CD	Compact Disc
CEC	Cooperative Engagement Capability
CENTCOM	Central Command
CEOI	Communications-Electronics Operating Instruction
CIA	Central Intelligence Agency
CINC	Commander in Chief
CIO	Central Imagery Office
CJTF	Commander Joint Task Force
CNN	Cable News Network
COE	Common Operating Environment
COMIFOR	Commander, Implementation Force
CONOPS	Concept of Operations
CONUS	Continental United States
COTS	Commercial-off-the-Shelf
DARPA	Defense Advanced Research Projects Agency

DBS	Direct Broadcast Satellite
dBw	Decibel Watts (decibel power level in watts)
DII	Defense Information Infrastructure
DISA	Defense Information Systems Agency
DISN	Defense Information Systems Network
DMS	Defense Message System
DNS	Domain Name Server
DoD	Department of Defense
DS	Desert Shield or Desert Storm
DSB	Defense Science Board
DSCS	Defense Satellite Communication System
DSS	Direct Satellite Systems
DTH	Direct To Home
EHF	Extremely High Frequency
EIMC	EUCOM Information Management Center
EIRP	Effective Isotropic Radiated Power
EUCOM	European Command
FCC	Federal Communications Commission
FOC	Final Operational Capability
FY	Fiscal Year
Gbps	Gigabits per Second
GBS	Global Broadcast Service
GCCS	Global Command and Control System
GFE	Government Furnished Equipment
GHz	GigaHertz
GRT	GBS Receive Terminal
GSM	Ground Support Module
HQ	Headquarters
IOC	Initial Operational Capability
IFOR	Implementation Force
IP	Internet Protocol
IRD	Integrated Receiver-Decoder
ISDN	Integrated Services Digital Network
ITU	International Telecommunications Union
JAC	Joint Analysis Center
JBS	Joint Broadcast Service
JCCC	Joint Communications Control Center
JCPMS	Joint Communications Planning and Management System
JCS	Joint Chiefs of Staff
JDISS	Joint Deployable Intelligence Support System
JFACC	Joint Forces Air Component Commander
JIC	Joint Intelligence Center

JIMC	Joint Information Management Center
JITC	Joint Interoperability Test Command
JITI	Joint In-Theater Injection
JORD	Joint Operational Requirements Document
JPO	Joint Program Office
JROC	Joint Requirements Oversight Council
JTF	Joint Task Force
JWICS	Joint Worldwide Intelligence Communications System
JWID	Joint Warrior Interoperability Demonstration
kbps	Kilobits per Second
LAN	Local Area Network
LDR	Low Data Rate
LES	Leading Edge Services
LOCE	Linked Operations-Intelligence Centers Europe
LOS	Line-of-Sight
MB	MegaByte
Mbps	Megabits per second
MDR	Medium Data Rate
MDU	Mission Data Update
MHz	MegaHertz
MILSATCOM	Military Satellite Communications
MLS	Multi-level Security
MND	Multi-National Division
MNS	Mission Need Statement
MRC	Major Regional Conflicts
MSE	Mobile Subscriber Equipment
MWR	Morale Welfare and Recreation
NATO	North Atlantic Treaty Organization
NDI	Non-Developmental Item
NIMA	National Imagery and Mapping Agency
NIPRNET	Non-secure Internet Protocol Router Network
nm	Nautical Mile
NMJIC	National Military Joint Intelligence Center
NRL	Naval Research Lab
NRO	National Reconnaissance Office
NSA	National Security Agency
OCM	Operational Control and Management
ORD	Operational Requirements Document
OSE	Open Systems Environment
OSI	Open Systems Interconnect
PIP	Primary Injection Point

RAF	Royal Air Force
RDM	Receive Data Manager
RF	Radio Frequency
RFI	Request For Information
SAR	Synthetic Aperture Radar
SATCOM	Satellite Communications
SBM	Satellite Broadcast Managers
SCI	Sensitive Compartmented Information
SFOR	Sustainment Force
SIPRNET	Secure Internet Protocol Router Network
SOF	Special Operations Forces
TAB	Theater Air Base
TADIL	Tactical Digital Information Link
TBM	Transmit Broadcast Manager
TCP	Transmission Control Protocol
TDC	Theater Deployable Communications
TENCAP	Tactical Exploitation of National Capabilities
TIBS	Theater Information Broadcast Service
TIDA	Tactical Information Dissemination Architecture
TIM	Theater Information Manager
TIP	Theater or Tactical Injection Point
TIS	Theater Injection Site
TPFDD	Time Phased Force Deployment Data
TRAP	Tactical Related APplications
TT&C	Telemetry, Tracking and Control
TV	Television
TVIS	Theater Virtual Injection Site
UAV	Unmanned Aerial Vehicle
UHF	Ultra High Frequency
UFO	UHF Follow-On
UFO/G	UHF Follow-On/GBS Transponder (G)
UK	United Kingdom
UN	United Nations
USCI	United Satellite Communication Incorporated
USCINCEUR	United States Commander in Chief Europe
USSPACECOM	US Space Command
VCR	Video Cassette Recorder
VSAT	Very Small Aperture Terminal
VTC	Video Teleconference
wpm	Words Per Minute
WWMCCS	World Wide Military Command and Control System

ACKNOWLEDGEMENT

There are several organizations and people whom I would like to thank for their extraordinary willingness to assist me in my research for this thesis.

I first want to acknowledge the personnel at CECOM, USSPACECOM, and the GBS Program Office for taking time out of their schedules to talk with me.

I am especially grateful for Lt Gwen Eckman at the Joint Information Management Center; Maj Virginia Ashpole, Margaret Rosa, and Richard Groller at the BC2A Program Office; Colonel John Weimer, Maj Bill Boronow and CPT Susan Tungate at USEUCOM; and Peter Stauffer, Tom Meals, John McHenry, and Ron Campeau at ARSPACE and ARINC who have been extremely generous and patient in providing me with information throughout my research efforts. I also want to thank the Air Force Institute for National Security Studies and Army Space Command for sponsoring this effort and providing the opportunity to meet and interview people at various different organizations.

At the Naval Postgraduate School, much credit goes to my advisors, Professor Boger and Professor Porter, for their patience and suggestions while researching and writing this thesis.

Finally, I reserve my biggest thanks for my wife and best friend, Kelly, and my children, whose support and patience through this experience are so very much appreciated.

EXECUTIVE SUMMARY

History should have taught us that there is never enough available communications. The story of the soldier in Grenada making a personal credit card call back to headquarters on a public telephone will be etched in military history books forever as a grand example of how interservice parochialism and stovepipe systems lead to a lack of communications interoperability that adversely affects a battlefield. Desert Storm taught us another hard lesson about how inadequate our communications capabilities are when compared to what we think we need. We have learned. We have improved our interoperability and our capabilities, but we can never get enough bandwidth.

The DoD has piggybacked on the advances of commercial industry in the area of Direct Broadcast Satellite (DBS) technology to open the floodgates of information a little wider for the warfighter. Through the coordinated efforts of many commands, services, agencies, and other organizations the Global Broadcast Service (GBS) Program was initiated to provide a near-term increase in the military's wideband communications capabilities. A prototype of the GBS, the Joint Broadcast Service, is an Advanced Concept Technology Demonstration program that was rapidly deployed as a major piece of the Bosnia Command and Control Augmentation (BC2A) system. The JBS was used by the United Nations Implementation Force (IFOR) in Operation JOINT ENDEAVOR, and is currently being used by the Stabilization Force (SFOR) in Operation JOINT GUARD, in Bosnia.

I began this research based on the premise that the JBS was being deployed to be a valuable addition and provide immediate impact to the coalition forces in Bosnia. The main thrust of the research dealt with the impact the use of the JBS had on forces deployed to Bosnia. More specifically, I wanted to determine the impact this new capability has had on the decision-making process at higher levels of command and its effect on JOINT ENDEAVOR operations. Chapter I of this thesis provides a short introduction, and Chapter II gives a brief history of the commercial DBS technology and outlines the basics of the GBS as a basis for discussion. Chapters III, IV, and V present an in-depth look at the JBS architecture, how it was used (specifics about the broadcast such as information flow and availability, dissemination, and management), and the effect it had on the operation itself and the associated decision making processes. Chapter VI looks at the requirement for a theater injection capability, the advantages and disadvantages of two possible solutions, and the prototype development effort for one of those solutions. Finally, Chapter VII outlines the lessons learned from this research as well as my conclusions and recommendations. Appendices A and B are included to provide detailed information about files broadcast via JBS and the information management procedures for the BC2A.

The JBS system has, at least in part, answered the joint warfighter's need for an improved high-bandwidth video and data distribution system. It provides the ability to broadcast full fidelity video, imagery, and data at high rates to small, affordable, and portable terminals throughout the theater.

As stated above, I began this research looking at the JBS as a new operational tool for the warfighter that would be a major player in providing Information

Dominance. However, as I got deeper into my research I realized that the JBS is not a well-developed system that was designed from the ground up for the military. It is a rapid prototype technology demonstration program and its *primary role* is to prove concepts and gain valuable experience to be applied toward the GBS program. Its *secondary role* is to provide a new tool for the forward deployed troops to use in their operations. Based on the results of my research, as summarized in this thesis, I determined that the JBS has performed its primary role superbly and its secondary role adequately.

Although JBS does have force enhancement capabilities, there is a collection of several things that have limited its effectiveness in Operation JOINT ENDEAVOR (as detailed in Chapters V and VII).

As the JBS continues to be used and improved the users will begin to recognize the capabilities it brings to the fight. The bottom line is that the JBS is not a panacea and does not solve our communications problems, but it is a definite success and its successor, GBS, will become one of our communications workhorses of the future.

I. INTRODUCTION

Information and information delivery systems are essential elements of combat capability. In spite of this realization military leaders have never had all of the information they felt they needed. Technology has greatly expanded the sophistication and capabilities of communications in an effort to provide access to more information. Having information superiority (more information than your enemy) can be critical to victory on the battlefield. Achieving information dominance goes beyond mere information superiority. To reach the DoD's goal of Information Dominance the military relies on having better technology and faster information delivery systems.

Commercial industry has pioneered the development of Direct Broadcast Satellite (DBS) technology that has become very popular in the television market. Capitalizing on commercial successes, the military has adapted DBS technology to meet the information needs of the military. This technology provides high volume information flow to any user with the appropriate receive equipment within the satellite broadcast coverage area (footprint). The military adaptation of this technology known as the Global Broadcast Service (GBS) will deliver a high-speed, one-way (for now[1]) information flow of video, imagery, and data to units worldwide. This will allow existing and planned two-way communications systems to support the lower volume, two-way traffic for they which they were designed.

The Joint Broadcast Service (JBS) is an operationally deployed test-bed for the

[1] Asymmetric back-channel technology being developed allows the DBS transponder to share a small amount of the downlink bandwidth for use in uplinking data from the DBS receive sites.

GBS used to support the United Nations (UN) operation in Bosnia. This thesis describes how the JBS works, what types of information are being sent via the JBS, the complete process of information distribution, and the impact the JBS has had on Operation JOINT ENDEAVOR and the associated decision making processes. The thesis then presents lessons learned, recommendations, and conclusions that are based on the results of this research.

I began this research based on the premise that the JBS was being deployed to be a valuable addition and provide immediate impact to the coalition forces in Bosnia. The methods used in gathering information for this research included personal interviews with individuals in many organizations involved in the development and fielding of the JBS, as well as some of the actual users of the system and its information products. Additionally, an extensive review of government documents, reports, and open source literature was conducted as part of this research effort.

Operation Desert Storm highlighted the need for more high-rate and high-bandwidth communications. The commercially developed DBS technology was exploited to provide this solution thanks to the coordinated efforts of many organizations. The next chapter will provide a detailed background on direct broadcast technology and the GBS. Chapter III discusses the Bosnia Command and Control Augmentation (BC2A) initiative and the JBS architecture. Chapter IV details JBS information operations - information types, availability, and processes. Chapter V presents the results of my research with regard to the impact of JBS on Operation JOINT ENDEAVOR and its associated decision making processes. Chapter VI provides a high level review of Theater Injection Point (TIP) requirements and TIP prototype development efforts.

Finally, Chapter VII outlines the lessons learned from this research as well as my conclusions and recommendations. Appendix A is included to give detailed information about the files broadcast over JBS and the availability of the JBS system not provided in the body of the thesis. Appendix B is a reproduction of the Information Management Annex to the BC2A Concept of Operations (CONOPS).

II. BACKGROUND

This chapter gives a brief history of the commercial DBS technology and outlines the basics of the GBS including its beginnings and development plans as a basis for discussion.

A. DIRECT BROADCAST TECHNOLOGY

Satellite broadcasting has been around for nearly twenty years. In 1976, the first C-band home satellite TV system was put into service in California [Ref. 1]. Those C-band systems required large and expensive antennas to receive broadcasts from local and national TV companies. Because these broadcasts were often illegally received, the TV companies started encrypting their signals, thus requiring the additional expense of decryption equipment.

The rapid growth of C-band receive only systems indicated a large potential demand for direct-to-home (DTH) satellite broadcasting, so the International Telecommunications Union (ITU) allocated the 12.2-12.7GHz band for DTH use. Then, in 1982, the Federal Communications Commission (FCC) authorized DTH operations and orbital slots and licenses were issued [Ref. 1].

The first commercial television DBS from a dedicated provider, using a leased Canadian satellite transponder, was implemented in 1984 by *United Satellite Communication Inc* (USCI). This venture failed because the company was unable to attract more than seven thousand customers, primarily due to the expense of the large satellite receive terminals [Ref. 1].

Several key technological barriers have been overcome to provide a commercially viable method for satellite television broadcasting to subscribers. These successes include high signal quality (CD quality audio and laser disk quality video), small receive antennas, and inexpensive equipment for the customer.

In a 1994 joint venture, *United States Satellite Broadcasting* (USSB) and *DirecTV* (a *Hughes* subsidiary) established a successful DBS operation for customers in the continental United States (CONUS). This system uses a three satellite constellation with broadcast centers in Castle Rock, CO and Oakdale, MN. The three satellites provide up to 200 channels of high quality television services received by 18" subscriber terminals (costing less than $700 each). This joint venture was so successful that over one million subscriber terminals were sold in the first year of operations [Ref. 1].

As a consumer of vast amounts of information, the potential benefits of direct broadcast technology for the military are huge. Although military requirements are substantially different from the commercial sector, a military direct broadcast capability is ideally suited to the Department of Defense's (DoD) need for affordable and capable bandwidth. In a 1994 study entitled *Information Architecture for the Battlefield*, the Defense Science Board (DSB) made this recommendation:

> To enhance the information services available to the CINC, component commanders and deployed warfighting forces, the [DSB] Task Force recommends that the BITF [Battlefield Information Task Force] explore the utility of a Direct Broadcast Satellite service. [Ref. 3]

The high data rates and large bandwidth associated with these types of satellites provide one-way transmission of imagery, television, and data to a variety of users. The DoD has taken this technology and developed a concept known as the GBS.

B. GLOBAL BROADCAST SERVICE (GBS)

The military's concept for GBS uses these same commercial technologies to deliver high rate data, imagery, and video products quickly to the warfighter using a small receive antenna. The Joint Broadcast Service (JBS) is a limited operational capability being used as a testbed in support of GBS Phase I development (discussed later).

There has been an alarming gap between military satellite communications requirements and the capabilities that are currently available. This gap will be narrowed by GBS, as shown in Figure 1, but not eliminated. Robert V. Davis, Deputy Under

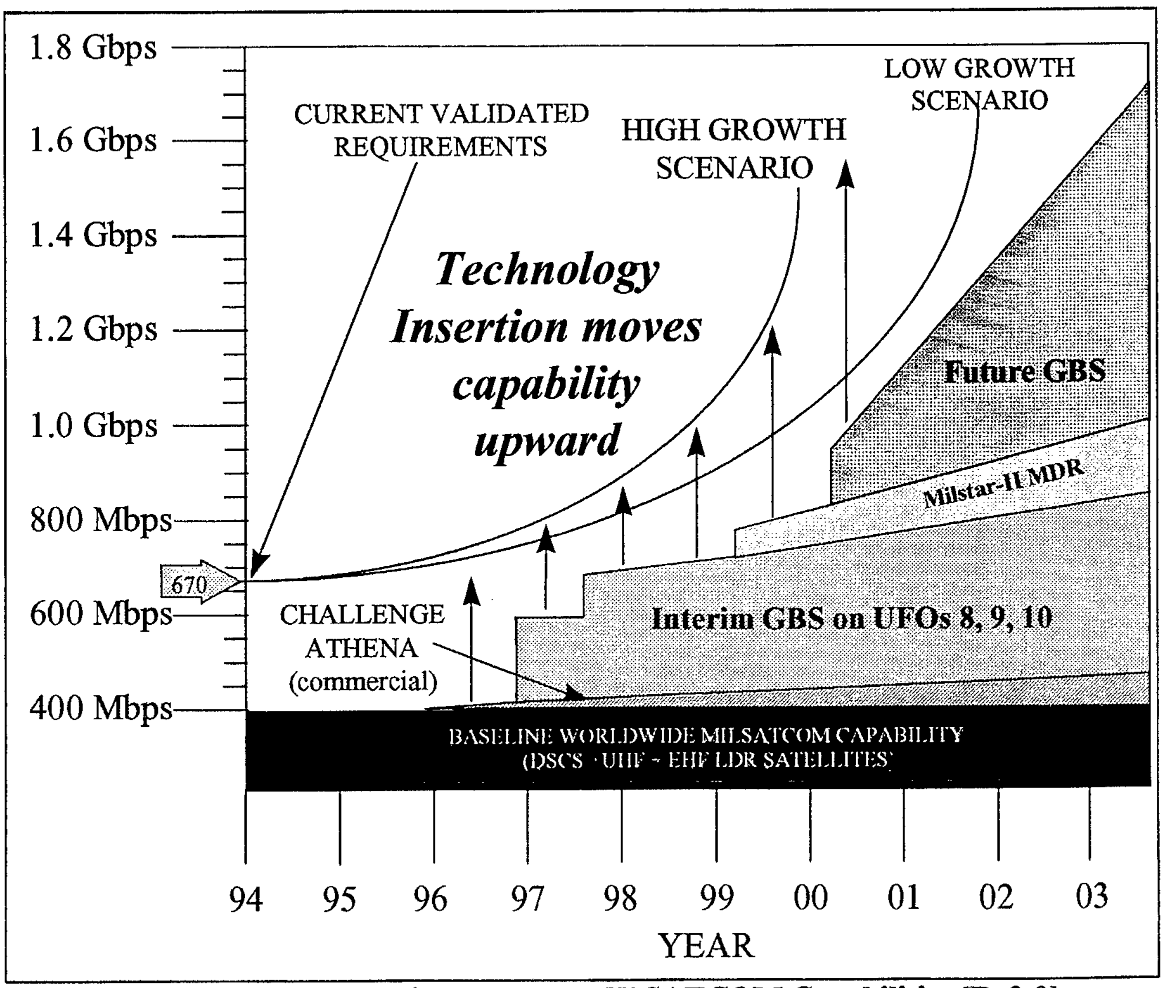


Figure 1. Future Requirements vs. MILSATCOM Capabilities [Ref. 9]

Secretary of Defense (Space), recognized this gap and made the following statement.

> In the SATCOM arena, we can no longer afford to go our own way and use commercial SATCOM as an afterthought. We've got to plan it as part of the answer up-front to make sure it fits with both the rest of our space architecture and the rest of our communications architecture. [Ref. 3]

Desert Storm highlighted the need for improved high-bandwidth communications to support deployed forces because of the failure of existing military satellite communications to do so. The shortfalls of the military communications architecture *and* the supporting civilian communications systems in providing responsive, high-capacity communications to deployed, mobile tactical units were highlighted in *The Conduct of the Persian Gulf War – The Final Report to Congress* [Ref. 2].

Most of the information received in theater during Desert Storm (DS) was flown in by aircraft. It was estimated that a communications capacity of 1 gigabit per second would have been required to keep up with the information demands experienced in DS. By the year 2010, that number is expected to be nearly 10 gigabits per second [Ref. 3]. Table 1 provides some statistics on communications capabilities during some historic U.S. conflicts.

1. GBS Beginnings

The Joint Chiefs of Staff (JCS) issued a Joint Mission Need Statement (MNS), in May 1995, which outlined the basic reasons the DoD needs a global broadcast capability and also delineated the high-level operational requirements for the GBS concept. The Joint MNS included the following requirements [Ref. 2]:

Year	Conflict	Communications Capacity	
1865	Civil War	Telegraph	30 wpm
1915	World War I	Telegraph	30 wpm
1965	Vietnam	Teletype	450 wpm
1991	Desert Storm	128 Kbps	192,000 wpm
1995	Bosnia	512 Kbps	768,000 wpm
1996	JBS in Bosnia	24.8 Mbps	37,200,000 wpm

Table 1. Information Transfer - Rate of Change [Ref. 4]

- "High speed, [one-way and near-real-time] multimedia communications and information flow to garrisoned forces and to in-transit and deployed mobile forces"
- "CINC and CJTF theater injection of information onto the broadcast"
- Use "small, lightweight, and inexpensive antennas and receivers"
- Use commercial off-the-shelf (COTS) and "non-developmental items (NDI) to the greatest extent possible"
- It "must be compatible and integrated with existing and planned in theater and centralized C4I systems such as . . . DISN"
- Must "accommodate broadcast transmission of all levels of information, from UNCLAS up to and including SCI."

On 3 August 1995 the Joint Requirements Oversight Council (JROC) reviewed and approved the MNS. A draft GBS CONOPS was then prepared and published for the JCS by the US Space Command in Aug 95 (a new version is currently being reviewed by the Joint Staff). The CONOPS "gives an overall picture of broadcast operations based on (1) a clear vision for improved information dissemination; (2) a system description; and

(3) an integrated approach for effective resource utilization and interoperability" [Ref. 5]. As opposed to the MNS, the CONOPS does go into high level explanations regarding the system architecture, broadcast services, transmission operations, system management, user operations, and roles and responsibilities. Figure 2 shows a graphical depiction of the GBS operational concept.

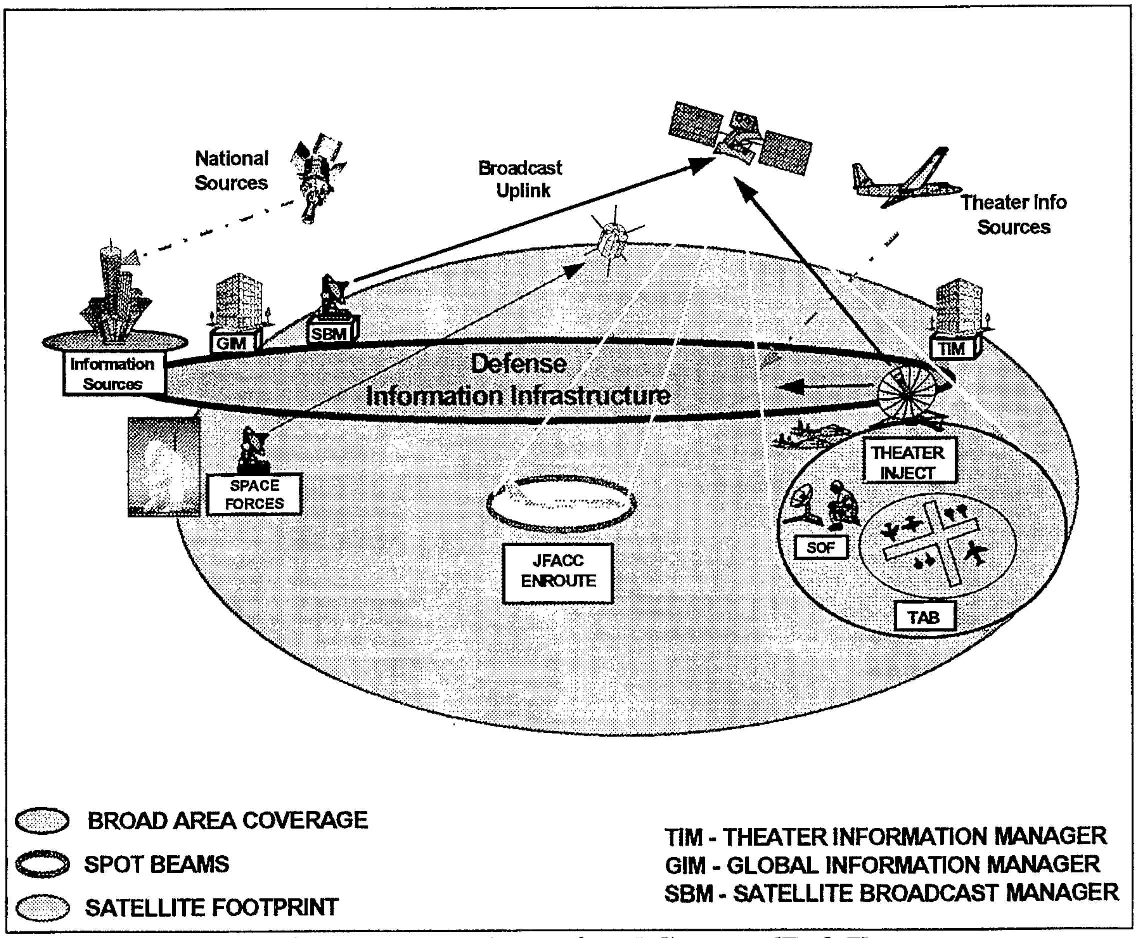


Figure 2. GBS Operational Concept [Ref. 7]

The GBS Joint Operational Requirements Document (JORD), written by the Army in 1995 (the latest version is dated 7 April 1997), briefly summarizes key points in the MNS and CONOPS, but was primarily written to specify many system requirements and performance parameters needed to aid in the acquisition process.

While the above documents were being finalized, a variety of DBS demonstrations were performed to evaluate the potential of this GBS concept. The first of these demonstrations, named Radiant Storm, was sponsored by the Navy Tactical Exploitation of National Capabilities (TENCAP) office. Radiant Storm demonstrated the ability to deliver commercial video and encrypted data to a remote user at T-1 rates (1.544 Mbps) using a leased commercial DBS transponder, an 18" antenna dish, and a commercial DBS receiver box. Building on this success, the TENCAP sponsored Special Project '95 demonstration during the Roving Sands exercise was the first broadcast to deployed units and also the first time that data management software was used. This demonstration differed from Radiant Storm by using a non-DBS satellite, a different frequency band, lower transmit power, and a 1 meter dish antenna but provided a higher overall data rate. Next, HQ AFC4A demonstrated the use of the full 23 Mbps broadcast capability and the use of Asynchronous Transfer Mode (ATM) in the DBS environment. Capitalizing on the use of ATM, the Joint Warrior Interoperability Demonstration (JWID) '95 encrypted an ATM broadcast and demonstrated "the interoperability of GBS technology with the current DoD communications architectures: Defense Information System Network (DISN) and the Defense Information" Infrastructure (DII) [Ref. 3].

As a result of these successes, in November 1995, about $900M in funding was allocated and a GBS Joint Program Office (JPO) established to manage the program, with the Air Force being named the lead agency/service for program development [Ref. 6].

2. GBS Development Plans

The development of the objective GBS capability will evolve through a three-phased approach. Phase 1 is a limited demonstration phase (FY96 - FY98). The focus of Phase 1 is [Ref. 3]:

- "Acquire and provide a limited off-the-shelf commercial capability to support selected exercises and concept development"
- "Initiate acquisition of the GBS space, ground, and user segments"
- "Determine products and applications which best suit" the CINC and subordinate JTF Commanders
- Develop information management tools and algorithms
- Further refine the CONOPS and initiate connectivity from information sources to GBS.

In support of these goals, one set of testbed equipment is being used to provide operational support to Operation JOINT ENDEAVOR in Bosnia. This interim capability is named the JBS and is part of a larger effort providing communications support to United Nations (UN) forces in Bosnia. This 'larger effort' is known as the BC2A Initiative and is managed by the BC2A JPO. The JBS portion of the BC2A is the focus of this thesis and will be discussed extensively in later chapters.

Phase 2 will provide an interim military GBS capability (FY98 - FY06+). In addition to incorporating the lessons learned from Phase 1, the focus of Phase 2 will be [Ref. 5]:

- "Launch Ultra-High Frequency (UHF) Follow-on (UFO) satellites 8, 9, and 10 with hosted GBS packages"

- Acquire user receive suites and continue to develop information and broadcast management systems
- Continue working to meet CINC and JTF Commanders' needs
- "Integrate GBS with MILSATCOM architecture and the DII"
- Complete connectivity to information providers and develop tools needed to integrate GBS with GCCS.

As stated above, UFO satellites 8, 9, and 10 will replace their originally planned SHF Fleet Broadcast transponders with GBS (EHF band) transponders and be designated as UFO/G satellites. The proposed modifications will give each UFO/G satellite:

- Two steerable 24 Mbps spot beams, each with a footprint of 500 nautical miles (nm) in diameter
- One steerable 1.544 Mbps wide area beam with a footprint of 2000 nm in diameter
- One fixed uplink antenna to receive data from the primary injection point
- One steerable uplink antenna to receive data from a theater injection point.

The Phase 2 design is not yet finalized, but these modifications would support the potential configuration shown in Figure 3.

The proposed GBS payloads for the UFO/G satellites, in the above configuration, gives each satellite a total coverage area of approximately 3.5 million square nautical miles [Ref. 5]. One potential drawback is that the UFO/G satellites will be launched into orbits of 4°-6° inclination requiring a satellite tracking capability at each receive site. Figure 4 shows the nominal locations of UFO/G 8, 9, and 10 with their respective fields of view.

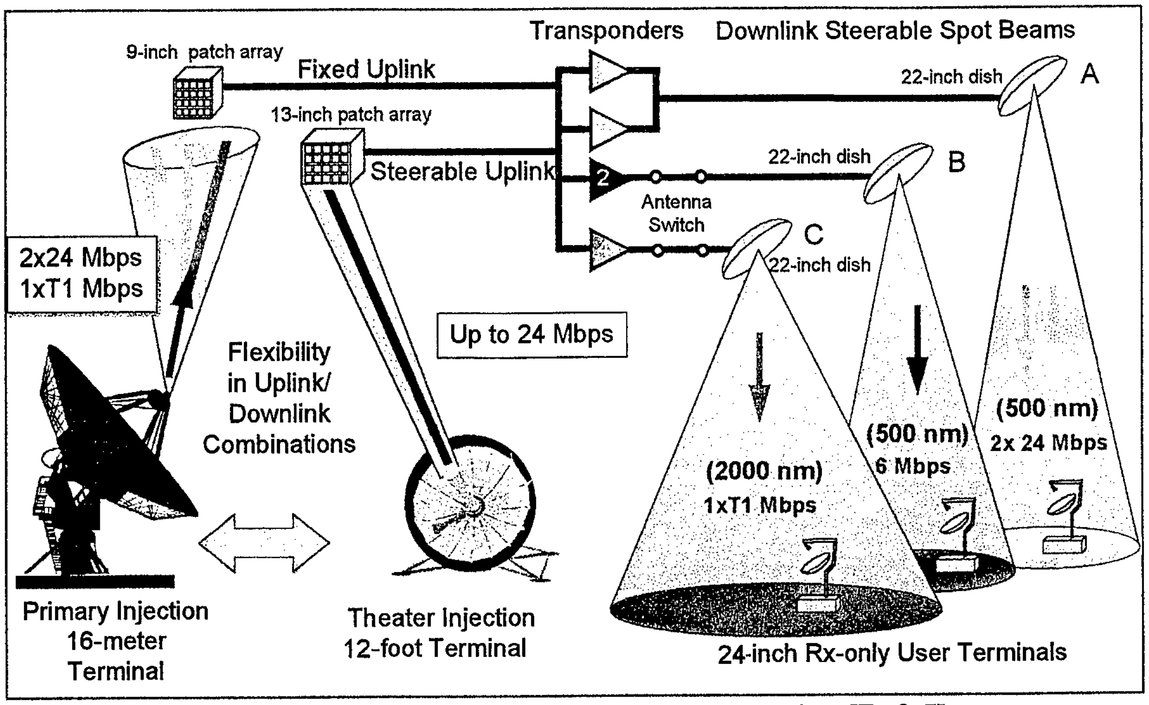


Figure 3. GBS Phase 2 Potential Configuration [Ref. 5]

Phase 3 will be the "Objective System" - the full-up GBS capability (FY06+). Based on the foundation laid by Phase 2 operations and user segment development, Phase 3 will [Ref. 5]:

- "Achieve objective capability"
- "Complete acquisition of space, ground, and user segments"
- "Complete integration with GCCS and other theater information management systems."

This Phase 3 system will provide worldwide coverage in the military Ka frequency band (30 GHz uplink/20 GHz downlink). Each satellite will have 7 steerable spot beams and a wide area coverage beam providing a maximum of 270 Mbps [Ref. 7].

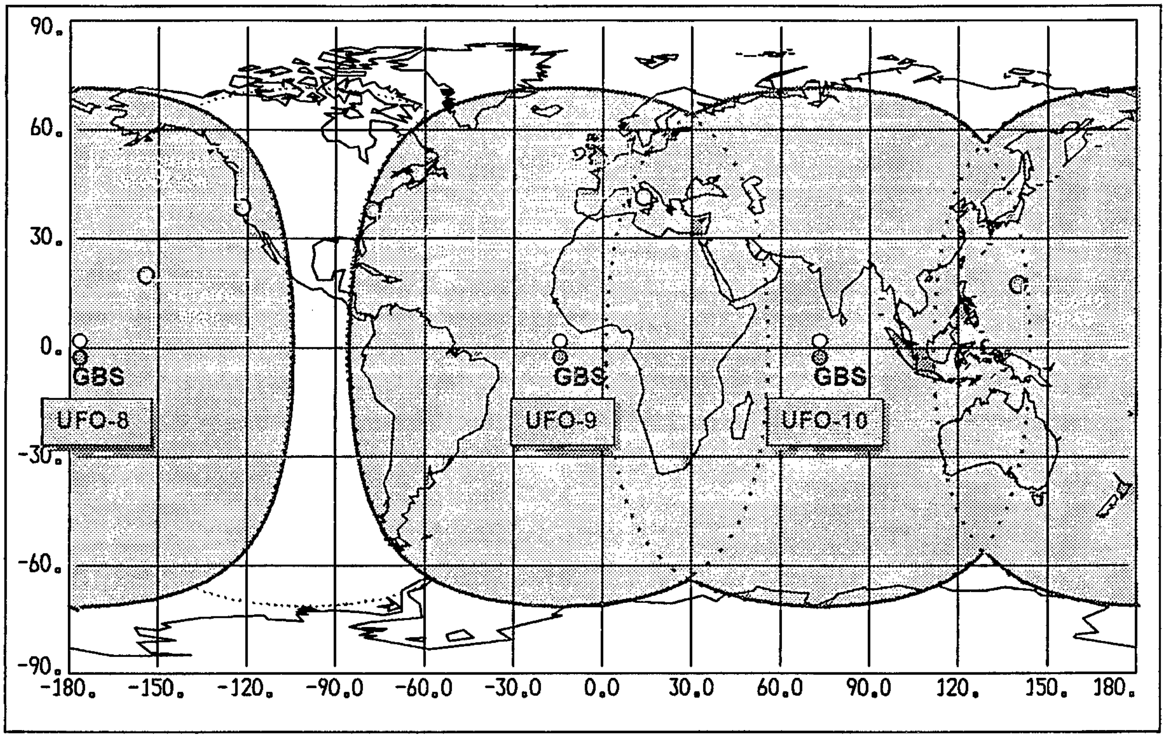


Figure 4. GBS Phase 2 Coverage [Ref. 5]

The GBS is expected to support US Allies and Coalition Forces engaged in two Major Regional Conflicts (MRCs) worldwide. Being a global *broadcast* service, its boundaries begin "at the interface with information providers and ends with the interface to the warfighters in their operational environment" [Ref. 5]. Figure 5 is a graphical representation of these boundaries.

> GBS will be a system of broadcast managers, injection points, broadcast satellites, and receiver terminals, as well as Operational Control and Management (OCM) processes for requesting and coordinating the distribution of information products .... GBS will be an integral part of the overall DOD MILSATCOM Architecture and the larger Defense Information Infrastructure (DII). [Ref. 5]

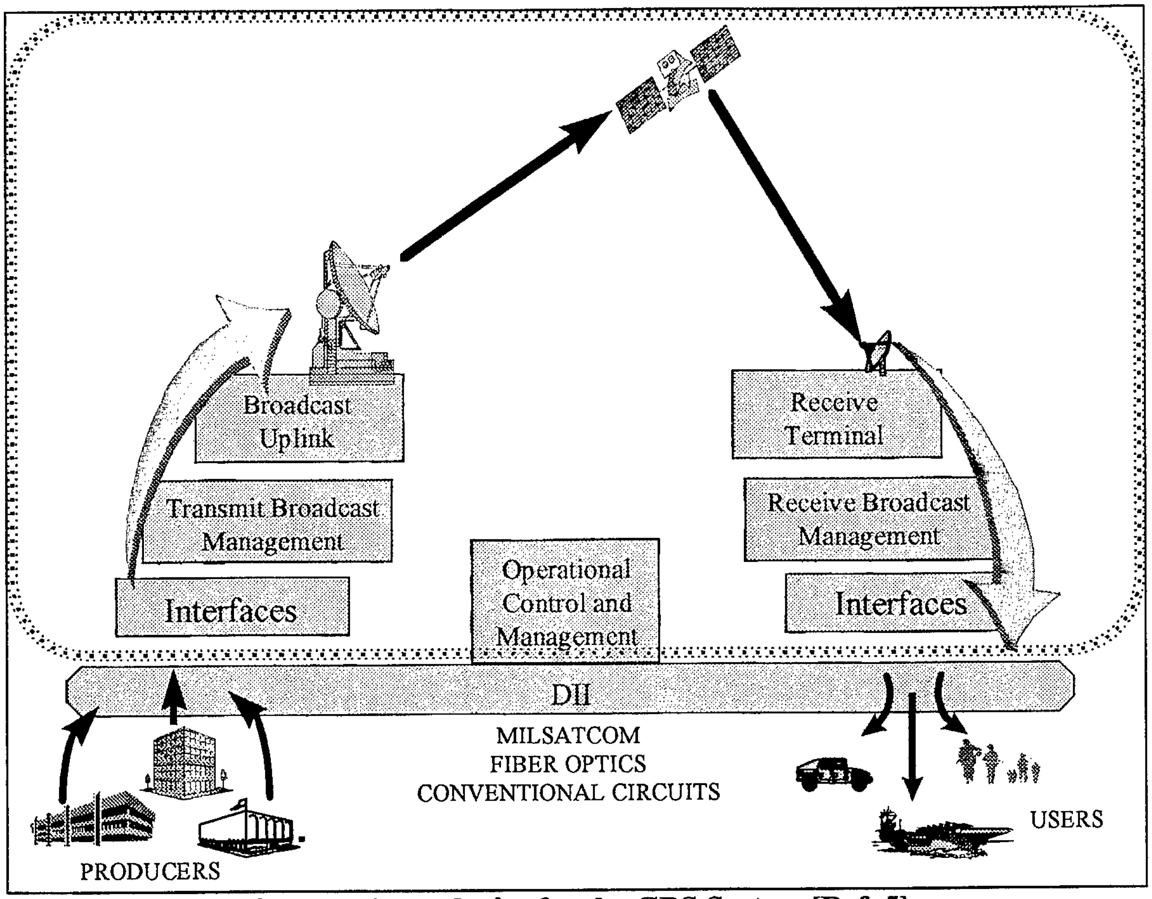


Figure 5. Boundaries for the GBS System [Ref. 5]

III. JBS ARCHITECTURE

The JBS is based on the same commercial DBS technology as GBS and plans to utilize the same type of "smart push/user pull" design as GBS to, hopefully, avoid 'information overload' to the end user. JBS broadcasts one-way, high bandwidth multimedia information to 29 receive sites throughout the European theater. However, to understand the JBS concept and architecture, we must first understand the BC2A initiative since JBS is a major component of the larger BC2A umbrella.

A. BOSNIA COMMAND AND CONTROL AUGMENTATION (BC2A)

The purpose of the BC2A is to achieve battlefield information dominance. "For this concept to be successful, one needs a unified integrated communication networking system, and that's really the objective of the Bosnian Command and Control Augmentation Program" [Ref. 3].

Air Force Manual 3-1 states "[Information] that would influence an operation or program is worthless if the commander receives it after the opportunity has passed, an irreversible decision has been made, or an operation is completed" [Ref. 10]. To support Operation DENY FLIGHT (the operation to protect the airspace over Bosnia during the spring and summer of 1995), several initiatives were undertaken to overcome the communications shortfall caused by large imagery and data files. The JBS was one of these initiatives designed to speed the flow of important information to the decision-maker. The Defense Advanced Research Projects Agency (DARPA) and the Defense Information Systems Agency (DISA) helped consolidate all of these efforts into a single initiative - BC2A. The stated objective of this initiative is to "support the Operation JOINT ENDEAVOR warfighter with timely and effective command and control information" [Ref. 11]. The BC2A system overview, as described in the BC2A CONOPS, is as follows:

> BC2A improves the exchange of information between force components deployed in the JOINT ENDEAVOR Area of Operations, command and control posts in the European theater, and government and military information sources in theater and in the continental United States (CONUS). It provides communications links as well as the computer hardware and software required to get vital information to the warfighter more rapidly than is possible with the existing architecture. BC2A capabilities are intended to augment rather than replace the existing theater command and control infrastructure with advanced, commercially available technologies. BC2A provides near-real-time, simultaneous dissemination of information down to the Brigade/Wing command levels along with advanced software tools to better manage this information. In addition, BC2A provides a field test-bed for components of the communications architecture that will ultimately be provided by the Global Broadcast Service (GBS). [Ref. 11]

The main components of the BC2A consist of the Defense Information Systems Network -Leading Edge Services (DISN - LES), Very Small Aperture Terminal (VSAT), and the JBS. These BC2A components are shown in Figure 6.

1. Defense Information Systems Network - Leading Edge Services

As shown in Figure 6, DISN-LES is a 45 Mbps (T3) fiber optic link providing two-way connectivity among RAF Molesworth, United Kingdom; Fort Belvoir, VA; many different information sources in the continental United States; supporting CINCs; and the Pentagon. This fiber optic link is capable of transmitting high bandwidth video and data files from point-to-point in real-time.

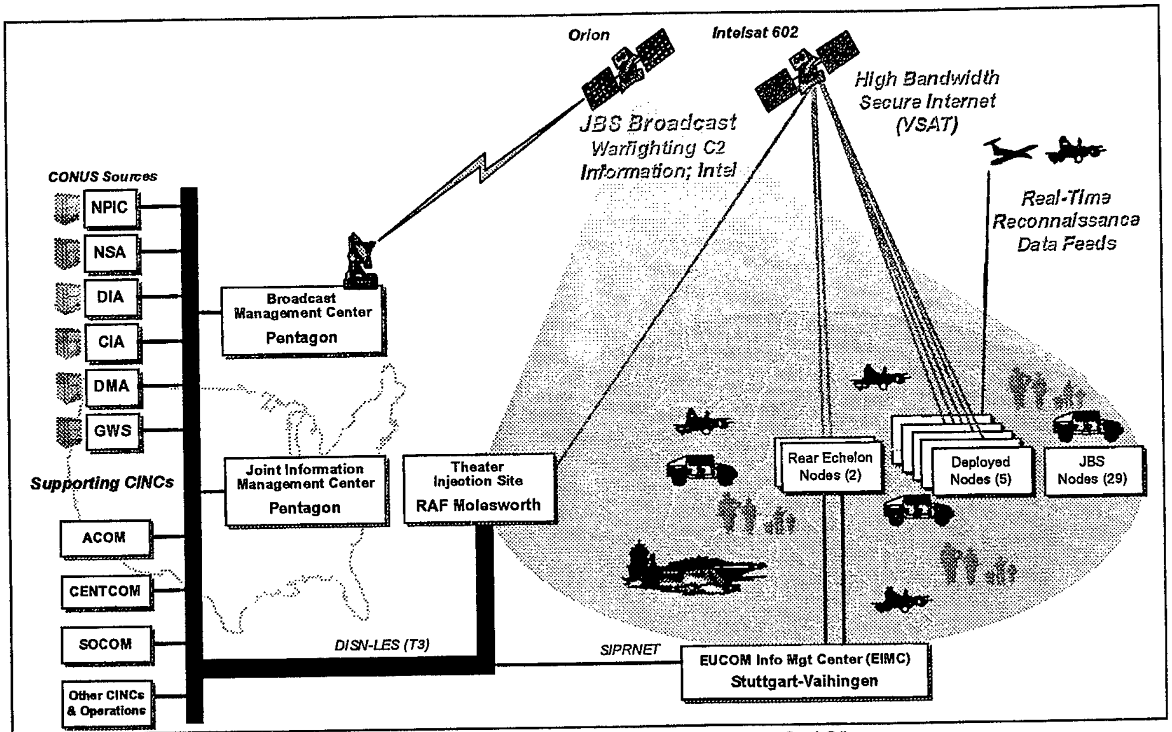


Figure 6. BC2A Architecture [Ref. 12]

2. Very Small Aperture Terminals

Although it also delivers a relatively high bandwidth capability, VSAT differs from JBS in that it is limited to a small number (eight) of receive sites and that it provides a responsive two-way capability. This system uses leased satellite transponders, transmit/receive equipment, and a 2.4 meter dish antenna to allow two-way high bandwidth communications between each of the eight sites. VSAT serves a critical role in the distribution of Unmanned Aerial Vehicle (UAV) reconnaissance video (e.g., Predator) by providing a satellite link to the Theater Injection Site (TIS) for subsequent broadcast through JBS. One of the most important things about VSAT, according to EUCOM personnel, is the video teleconferencing and whiteboard capability that allows interactive distributed collaborative planning.

B. JOINT BROADCAST SERVICE SYSTEM DESCRIPTION

The JBS is an integral part of the BC2A. It became operational on 6 Apr 96 and had a total of 9 receive sites (5 ground and 4 ships). This initial capability had one US SECRET Internet Protocol (IP) 2 Mbps data channel [Ref. 13] and four 4 Mbps high quality full motion video channels [Ref. 4]. By 1 Aug 96, a 2 Mbps REL-NATO IP data channel was added and later upgraded to the NATO SECRET level [Ref. 13]. Today there are 29 JBS receive sites in EUCOM's AOR supporting Operation JOINT ENDEAVOR using an aggregate of nearly 30 Mbps.

The JBS has three primary segments: (1) the broadcast segment, (2) the terminal (receive) segment, and (3) the space segment.

1. Broadcast Segment

The broadcast segment includes the Joint Information Management Center (JIMC), located at the Pentagon, and a Theater Information Manager (TIM) for each theater (for JBS this is the EUCOM Information Management Center (EIMC) located at Stuttgart, Germany). The JIMC retrieves information products from national and theater information sources. These products are then stored and added to a product catalog, making them available upon request to support "user pull." The EIMC also develops dissemination policies and priorities for its area of responsibility, including "approving the JBS video broadcast schedule and channel allocations" [Ref. 12].

The Broadcast Management Center (BMC), co-located with the JIMC at the Pentagon, is the point where data sources are injected onto the broadcast (on a modified first-in, first-out (FIFO) basis) using the Internet Protocol (IP) and Asynchronous Transfer Mode (ATM). "The BMC receives information to be broadcast from the JIMC, sets the uplink schedule, and uplinks that information to the satellite" [Ref. 12]. Two classes of data are supported - IP data files from sources via the SIPRNET and streaming data inputs (streaming data is a continuous stream of video/data received at the BMC and packetized for broadcast, e.g., processed TRAP and TIBS data). "Operators at the BMC are able to modify the precedence of files in the queue, pause their transmission, remove them from the broadcast, or change the order of files within the precedence level" [Ref. 13].

2. Terminal (Receive) Segment

> The basic JBS Receive Suite at a receive node consists of a 1 meter antenna with processing and display hardware packaged in four protective cases weighing a total of 500 lb. and occupying 60 cubic feet . . . Sites with simultaneous viewing requirements receive an extra television and [Integrated Receiver Decoder] IRD. Sites with multiple-level security requirements have separate receive data equipment strings and separate KEYMAT . . . This suite can simultaneously process two channels: one unclassified video with encrypted dual-channel . . . and one encrypted data channel. An Uninterruptable Power Supply (UPS) is included to provide power conditioning and allow 5 minutes for graceful system shutdown . . . Each JBS receive suite consists of: 1 meter antenna, Low Noise Block (LNB), Integrated Receiver Decoder (IRD), TV, VCR, KG-94A, Data Bridge, CISCO router, SPARC 20 workstation, and Receive Data Manager (RDM) software. [Ref. 13]

The JBS receive suite comes in one of two configurations - JBS receive only (video and data) or JBS video receive only. The video receive only version comes with only enough equipment to receive video (i.e., IRD, TV, VCR, and antenna) - "it is physically incapable of receiving the data portion of the JBS broadcast" [Ref. 11].

As noted above, each receive suite can be slightly different based upon the desired capabilities at the site. These differences in capabilities are accommodated by including modular containers with additional equipment. Figure 7 shows the JBS receive suite with the additional equipment needed to allow the site to store information and act as a small information server.

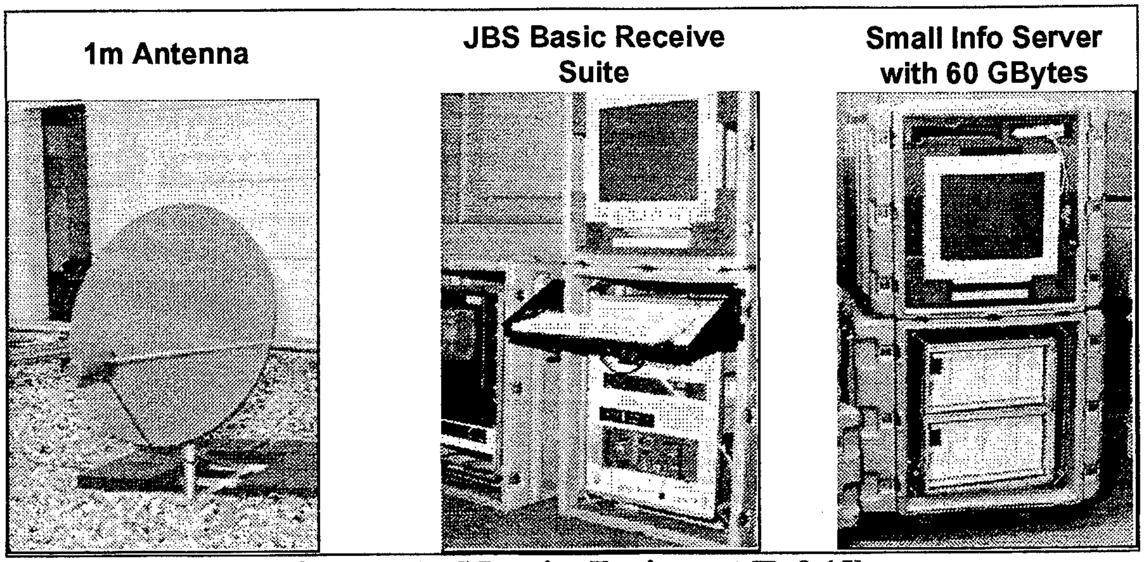


Figure 7. JBS Receive Equipment [Ref. 15]

The IRD, sometimes referred to as a 'set top box,' is the key element of the JBS receive suite that has enabled the low cost, portable, state-of-the-art functionality [Ref. 13].

> The IRD (about the size and weight of a standard VCR) provides MPEG2 processing of digitized video and outputs to a standard NTSC TV. Additionally, the IRD can output high speed data to an 8 bit wide parallel port. These functions cannot occur simultaneously. Therefore, an IRD must be dedicated to each broadcast channel required for simultaneous, constant use. The IRDs used for JBS are specifically modified to eliminate the conditional access and DES encryption systems normally found in an off-the-shelf IRD. [Ref. 13]

As opposed to the 18" antenna for commercial direct broadcast television, the 1 meter JBS receive antenna helps overcome potential co-channel interference from adjacent satellites. The larger antenna also makes up for the slightly weaker signal

Figure 8 shows the locations of the JBS receive sites in EUCOM and Operation JOINT ENDEAVOR.

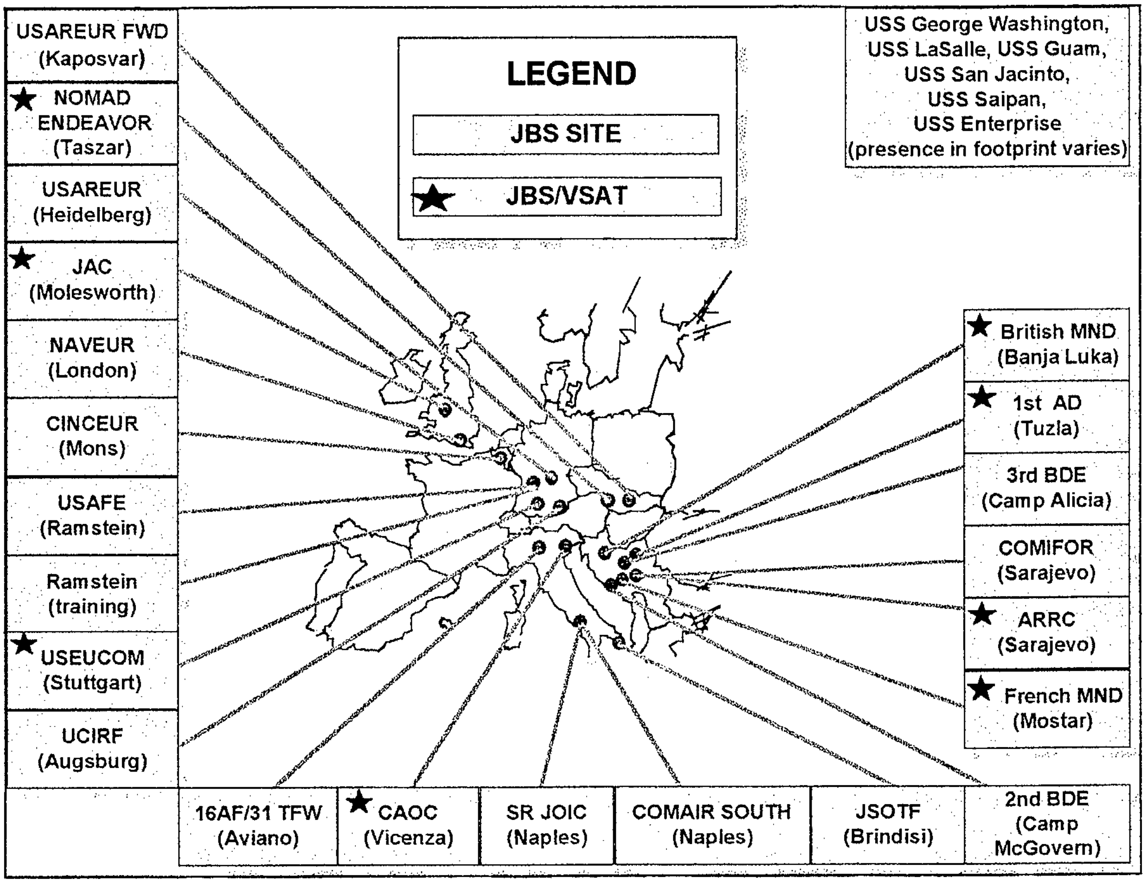


Figure 8. JBS Receive Sites [Ref. 15]

3. Space Segment

The JBS uses a leased Ku band transponder on the Orion Atlantic-1 satellite, located at 37.5° west longitude, to provide European spot beam coverage [Ref. 13]. The Orion-1 satellite provides an antenna to receive the uplink from the Pentagon and is capable of delivering a 30.3 Mbps broadcast signal to the European theater.

The uplink frequency is 14.281 GHz with a maximum uplink power of 300 watts from a 3.7 meter center fed reflector mounted on the rooftop of the Pentagon [Ref. 13]. The downlink signal into USEUCOM is at 11.483 GHz and is horizontally polarized, The downlink signal into USEUCOM is at 11.483 GHz and is horizontally polarized, providing a power output on the earth's surface that ranges from 49 dBw (Adriatic Sea & Italy) to 39 dBw (UK, Central Europe, central Mediterranean Sea) as shown in Figure 9 [Ref. 13].

These three segments (broadcast, receive, and space) make up the Joint Broadcast Service that allows data and imagery products to be delivered to the warfighter in a more timely manner than is otherwise possible. The use of proven COTS technology and small receive antennas has kept the overall costs down and allow tactical and other 'communications challenged' users to have access to JBS capabilities.

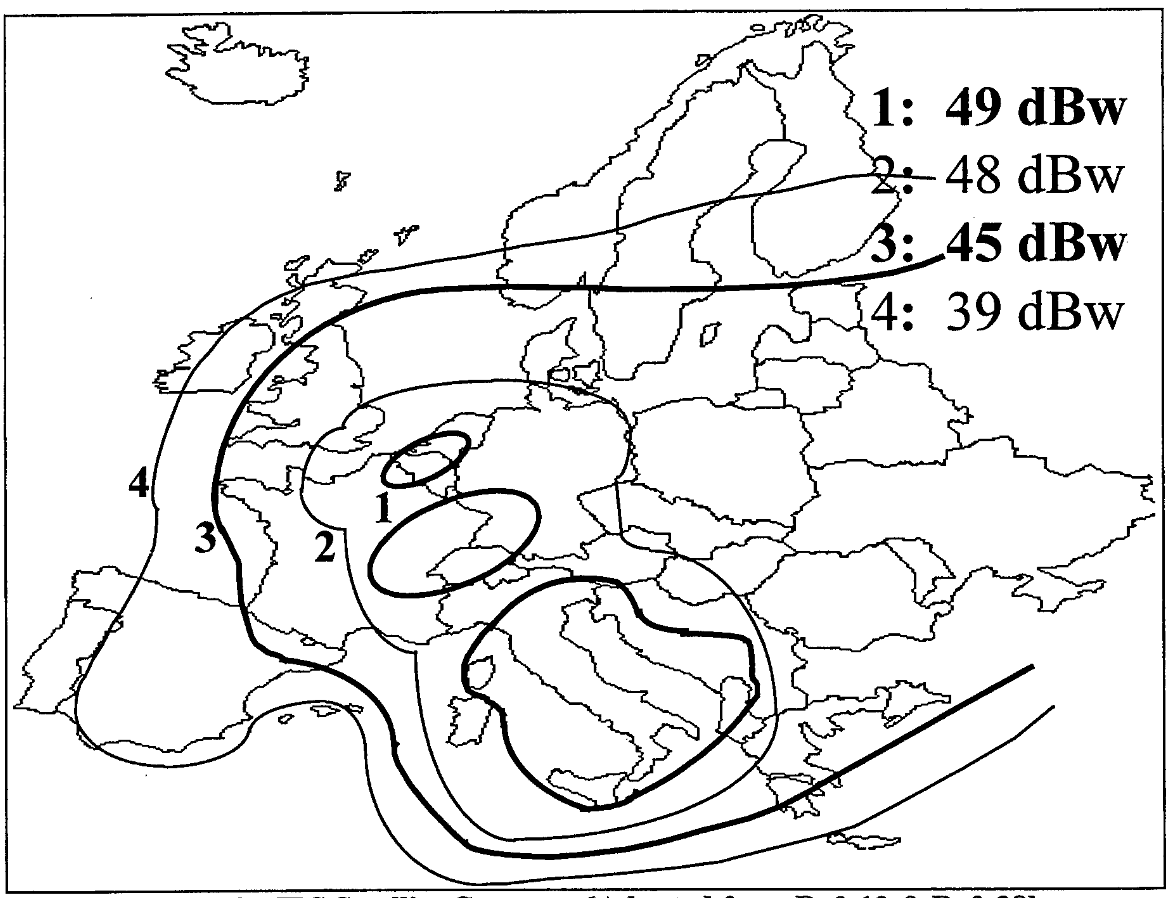


Figure 9. JBS Satellite Coverage [Adapted from Ref. 13 & Ref. 38]

Since JBS is a one-way broadcast capability, how does the user specify what information is needed? The JBS concept employs the "smart push/warrior pull" idea espoused in nearly all of the 'C4I For The Warrior" documentation. This concept, including the actual information flow in the Bosnia Theater (from push/request to receipt) and types of information available, will be addressed in the next chapter.

IV. JBS INFORMATION OPERATIONS

One of the most important lessons learned from DESERT STORM was that the U.S. Armed Forces did not have adequate communications capabilities to handle the information requirements in theater. It was very difficult, if not impossible, to disseminate large products (e.g., imagery and the Air Tasking Order (ATO)) to the necessary users within the theater of operations. This was not only due to the lack of communications resources but also to the lack of standardized file types. Additionally, because simultaneously sending to multiple users (multicasting) was not usually possible distribution of standard products to many users required multiple retransmissions over dedicated communications links. This caused many links to be unavailable for other uses for long periods of time. Thus, the true stories of aircraft flying copies of the ATO to users on a daily basis and the need for three C-5 aircraft to fly copies of the Communications-Electronics Operating Instruction (CEOI) into the theater for further dissemination [Ref. 16].

The use of DBS technology now makes broadcast transmission of high bandwidth information to the warfighter possible. Figure 10 shows a theoretical data throughput comparison of various systems. Because of JBS, full fidelity video, imagery, and data can be multicast throughout the theater for direct exploitation by the warfighter. This chapter will discuss JBS in terms of information flow and availability, dissemination after receipt, and management.

A. INFORMATION FLOW AND AVAILABILITY

Any number of different agencies (e.g., DISA, NIMA), combatant commands (e.g., EUCOM, CENTCOM), and commercial sources (e.g., CNN) can generate data or video for broadcast on JBS, at the SECRET level or below, in support of Operation JOINT ENDEAVOR. With the vast array of information producers available, the user must to carefully determine the information requirements needed to accomplish their specific mission. The user must be able to readily obtain accurate information and not have to wade through virtual 'piles' of information that were 'pushed' on the user. As an example, late in 1996, "it was common for 100-200 files to be pushed a day" [Ref. 12] and operators would have to manually search through these files to find the ones that they needed.

	Representative System and Throughput				
SATCOM Throughput / Example Info	2.4 Kbps (for example) Milstar & UFO	56 Kbps (for example) WWMCCS	512 Kbps (for example) GCCS	1.544 Mbps (for example) T1 Line	23 Mbps GBS
Tomahawk MDU 0.03 Mbytes	100 sec	4.29 sec	0.47 sec	0.16 sec	0.01 sec
Air Tasking Order (DS) 1.1 Mbytes	1.02 hr	2.61 min	17.19 sec	5.7 sec	0.38 sec
8X10 Imagery Annotated 24 Mbytes	22.2 hr	57 min	6.25 min	2.07 min	8.4 sec
DS TPFDD (log support) 250 Mbytes	9.65 days	9.92 hr	1.09 hr	21.59 min	1.45 min

Original Data from NRO

These numbers refer strictly to information content and do not account for encryption, error correction, wrapping, or overhead bits which can vary depending on the transmission system used. Transmission times calculated using: [8 data bits per byte * message size] / system throughput.

Figure 10. Data Throughput Comparison [Ref. 17]

Although "All information is broadcast with an identifying wrapper that allows receiving sites to ignore information in which they are not interested and thus prevent information overload" [Ref. 11], it doesn't really work very well for 'pushed' information. There is a growing feeling among users that there is no such thing as a 'smart push.' Instead, many are advocating a subscription policy for standard products that will be broadcast on a regular basis. With this concept users would receive only those products that they have specifically requested because the products would be specifically addressed to the users with a subscription. This allows the users to better manage their assets and avoid getting buried by 'Pentagon-Pushed' information that may be useless to the individual user. Under the 'Smart Push (or Subscription)/Warrior Pull' concept, JBS provides two types of service and three product delivery classes.

The two types of service are: Inter-theater and Intra-theater. Inter-theater service refers to the flow of information from the CONUS to EUCOM via broadcast over the Orion satellite. Inter-theater service is handled in the following manner. Based on a received information requirement, the JIMC requests the information from one of its various information sources. After securing the information, the JIMC coordinates with the BMC to queue the information for a future broadcast. The information is then sent via the DISN-LES to the BMC, uplinked to the Orion satellite, and then broadcast to receive terminals throughout the European Theater.

> Intra-theater services (EIMC) focuses on information from USCINCEUR/JOINT ENDEAVOR sources to component/sub-component levels. Intra-theater sources must be moved from the USEUCOM Area of Operations to the CONUS for incorporation into the JBS broadcast. [Ref. 13]

Intra-theater service refers to the broadcast of information that originates from within the theater such as Unmanned Aerial Vehicle (UAV) video, reconnaissance imagery, and ATOs created at the Combined Air Operations Center (CAOC) in Italy. This information must be sent to the Theater Injection Point (TIP) at RAF Molesworth, UK. The TIP has equipment and "software capable of wrapping data files for direct injection into the JBS" [Ref. 19]. From there it is shipped to the BMC, via the trans-Atlantic DISN-LES link, uplinked to the Orion satellite, and finally broadcast back to receive terminals in the European Theater. This is known as a virtual injection capability since the TIP does not have a direct uplink capability to the Orion satellite.

The three classes of product delivery are: Continuous and Periodic (Push/Subscription), and On-demand (Pull).

> Continuous and Periodic (Push) Products. These broadcasts may be CINC, Service, or Agency-unique and are available to all JBS-equipped units in the broadcast footprint. The JBS is a primary means of moving time-sensitive, high-volume sensor data in near-real-time to other sensor systems for tip-off and queuing, and to theater and tactical intelligence and analysis activities for rapid exploitation. Additional examples of the [pushed] data may include:
>
> Operations -- Air Tasking Order (ATO), global weather, imagery, unclassified UAV video, local weather forecasts, ELINT warning.
>
> Intelligence -- Daily intelligence briefings, intelligence updates, and imagery composites.
>
> Administrative -- Message traffic requiring broad dissemination, education/training, payroll, medical.
>
> Logistics -- Inventories, asset visibility.
>
> MWR -- News, training/education, AFRTS, Stars & Stripes, Early Bird.
>
> Other services specified by USCINCEUR. [Ref. 13]

On-Demand (Pull) products refers to the ability of JBS users to order specific information products from the JIMC for receipt via a future broadcast. These specific requests may or may not be for products in the product catalog. Requests are made electronically via the DISN-LES as depicted in Figure 11 (1-2, information request; 3-4, request acknowledged; 5-7, information is obtained and broadcast to site; 8, site acknowledges receipt) or they can be made directly to the JIMC via fax, phone, teletype, or whatever other communication means the user has. Details of this process can be found in the BC2A Concept of Operations [Ref. 11].

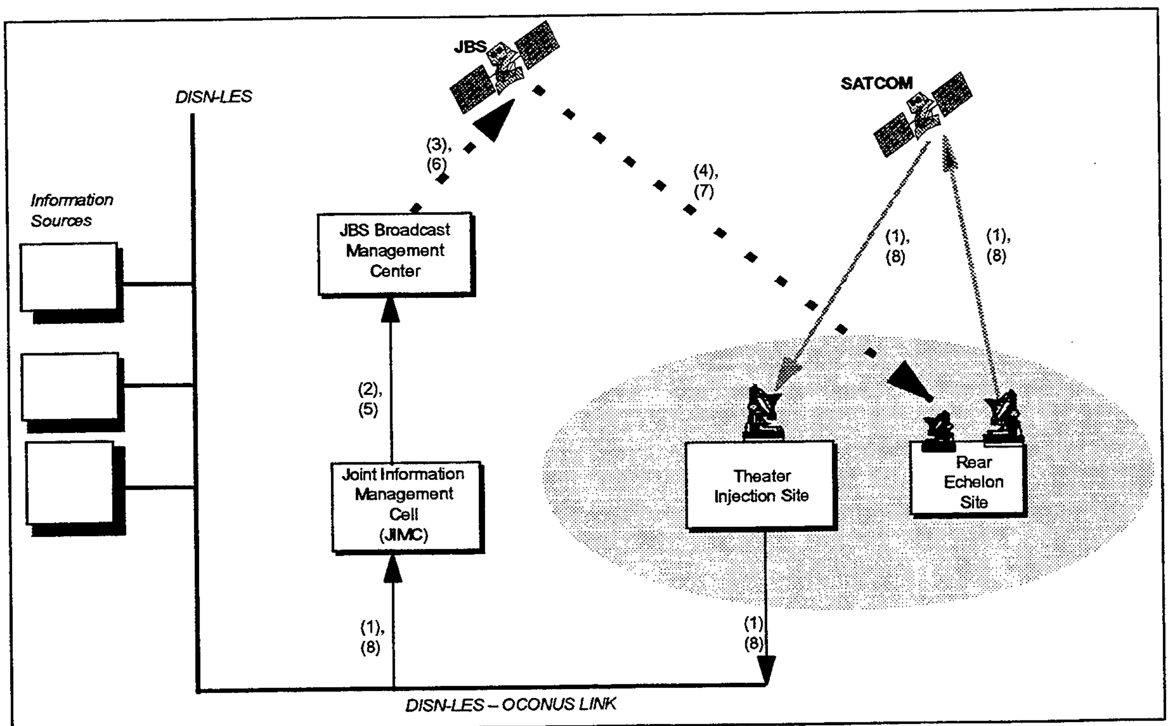


Figure 11. Possible Method for Product Request [Ref. 11]

Since there are many products competing for the bandwidth provided by JBS it has been divided into a few separate areas for use. All products will be broadcast under one of the headings shown in the Table 2. The products available to the warfighter on either a push/subscription or as-requested basis are shown in Table 3 (shows only those products with UNCLASSIFIED titles). Additional products are added to this list on a regular basis. Those products that are available on a subscription basis are sent to the users based on a broadcast schedule that is developed by the BMC. Additional information regarding 'standard' file types, sizes, and numbers are shown in Appendix A.

JBS Bandwidth Allocations		
	Video	Audio
CNN	3 Mbps	256 kbps
AFRTS	3 Mbps	256 kbps
Predator (UAV)	3 Mbps	-------
OSD Press Briefing	1.5 Mbps	128 kbps
US Secret IP Tunnel	3 Mbps	-------
NATO Secret IP Tunnel	1.6 Mbps	-------
US & NATO Secret ATM	13.2 Mbps	-------
Program Guide	200 kbps	-------

Table 2. JBS Bandwidth Allocations [Ref. 20]

B. INFORMATION DISSEMINATION

Lieutenant General William J. Donahue, Air Staff Director of C3 Systems, stated:

> We see a huge information appetite in future weapon systems and support functions. Just-in-time logistics, intelligence, command and control - all these are driving information requirements up big-time. But we'd rather move information than move support troops to the field. [Ref. 3]

GBS, and therefore JBS, was envisioned to be a communications system that would provide a satellite communications capability to the 'disadvantaged' user (e.g., light, mobile forces). The "C4I For The Warrior" concept spawned the phrase 'C4I To

The Foxhole' as that was the advertised plan. Someday this may happen, but not yet. JBS is still a tool for commanders and their staffs.

Because the number of JBS receive terminals is still limited they are not supplied to lower echelon units, and their size makes it difficult for dismounted infantry or Special

JIMC Daily Broadcast Product Catalog	
Daily Balkan Intelligence Summary	Theater Intelligence Digest
Balkan Graphic INTSUM	JAC EUCOM Intelligence Report
Heavy Weapons Baseline	Air Order of Battle
Defensive Missile Order of Battle	Electronic Order of Battle
Ground Order of Battle	Naval Order of Battle
JAC Western Algerian Situational Analytical Summary	JAC Terrorism-Counter Intelligence Force Protection Summary
Parametric Electronic Order of Battle	Commander's Intelligence Update - "Pinks"
Daily DIA/NMJIC J2 Brief	Chairman's Daily Operations Brief
Daily DIA/NMJIC Executive Highlights	Daily DIA/NMJIC Overnight Developments
BC2A Daily Site Status Report	NMCC Daily Briefing
CNN, USA Today and IGES Weather for Europe	Airfield Summary Information
12-24 Hour Surface and Flight Forecasts	24-48 Hour Surface and Flight Forecasts
AFGWC Forecasts	72 Hour Forecasts
Naval Weather Forecasts	Today's Conditions
6th Fleet Forecasts	METOC Weather from Rota, Spain
Satellite Images - Visual and IR	LRC Morning Update
Early Bird	Stars and Stripes
Times Fax	SIRO Daily Press Review

Table 3. Product Catalog [Ref. 18]

Operations Forces (SOF) teams to use them. The bottom line is that JBS is not currently available to 'users on the move' or lower level units. It is being used as a large bandwidth pipe to get imagery, intelligence, and other products to planners and analysts and news and briefings to commanders and staff.

In some cases, the JBS equipment is tied into the Local Area Network (LAN) which vastly increases the potential number of users of the information. However, this assumes local users know it is there and know how to get to it. In most cases, JBS communications equipment is not connected to the LAN, and it's a new system that people are not familiar with so they don't use it. A recently released report from a Defense Science Board (DSB) Task Force states, "There is a tremendous amount of information that never gets to users, because they don't know where to find it and don't have effective tools." Also, "Critical intelligence was not getting to lower-echelon U.S. forces in Bosnia while field commanders were at times overwhelmed by a torrent of useless information." Thus, outside of the primary group of users (i.e., commanders, staff, planners, and analysts) there is very little dissemination of JBS products. [Ref. 21]

Additionally, working in a multi-national coalition environment adds its own twist because of cultural differences. For example, some nations disagree with the very premise of a broadcast system because they like to maintain a close hold on information. Whether this is due to habit, cultural background, security concerns, a desire to have higher headquarters be the repository of information, or some other reason is irrelevant; if the military leadership of another country (especially in the multi-national division (MND) arrangement used in Bosnia) does not believe that information should be shared freely, the whole system is rendered less effective and gives the coalition an information reservoir instead of information dominance. A multi-national coalition such as this will never operate as a single integrated force until they are all operating from the same information paradigm.

A recent trip report from JIMC personnel, after two weeks of site visits throughout Bosnia and Europe, states:

> The bottom line issue here is that the people who need to use the products for the most part don't have access to them. Also, I'm not sure if everyone who *could* use the JBS knows of its existence. [Ref. 22]

C. INFORMATION MANAGEMENT

With the large bandwidth JBS 'pipe' information management should be one of the highest priorities. Unfortunately, this is probably the least mature area of the JBS. The EIMC developed the Information Management Annex to the BC2A CONOPS (contained in Appendix B) as well as the interim procedures until the software and tools necessary to implement the CONOPS are in place [Ref. 12]. However, a written statement of what will be available doesn't help the current users of the system.

Since the JBS became operational, information management has been an issue. In November 1996 a report was released stating the findings of an oversight visit to four BC2A sites in Bosnia. The report states, "Information management is not in place at these sites" [Ref. 23]. It went on to state that the information management policy was not yet implemented and "there are no information management tools . . . to help the user" [Ref. 23].

> Users were receiving hundreds of weather files, none of which they were using. The files they did use . . . had to be manually retrieved from the system. This is exactly the situation the EIMC anticipated if sources were allowed to push items to users that the users did not request . . . By not having the system perform according to the EIMC plan, we are turning off

> users and actually making use of the system more difficult than existing systems . . . . [Ref. 23]

Although, many of these problems have, at least partially, been resolved by a recent software upgrade that began being installed in late March 1997, there are still many information management hurdles to overcome. The challenge will be to develop an automated method to implement the policies and procedures based on emerging commercial information technologies to allow the user to go straight to the information and get it without complex intermediate steps [Ref. 19]. This capability also needs to support multiple levels of security and the coalition du jour environment that we are in. This is required because "the military views information . . . as a force multiplier and requires that it be protected and selectively released to coalition partners under well defined rules and control" [Ref. 24]. A report published by the National Defense University states, "Managing all of the information available to the commander and his staff was a serious problem. Users did not have adequate tools to search for available information" [Ref. 24].

The Washington Post summarized a DSB report with the following:

> The 64-page report described a "broken communications pipe" between Army brigades in the field and command headquarters. The break was caused by a poor understanding of what information is available, a lack of communications "band width" to handle massive amounts of data, equipment failure, and an inability to sort through and exploit the intelligence that is available. [Ref. 21]

JBS is a way to provide the communications bandwidth to handle these 'massive amounts of data.' In many cases JBS does provide useful support and a way to transmit electronic information and data that has only been dreamed of in the past. However, there are several factors, to be explored in the next chapter, that have limited the effectiveness of JBS in Operation JOINT ENDEAVOR and kept it almost completely out of the decision making process.

V. JBS EFFECTIVENESS

Today's environment of shrinking budgets and military drawdowns forces the DoD to continue to exploit the successes and breakthroughs in commercial technology in order to reach the DoD's stated goal of Information Dominance. Just because we have more knowledge or data than our enemy does not mean we have information dominance. In fact, this is a very dangerous subtlety that many people miss. All of the data or knowledge in the world is worthless if it cannot be *used*. It is the *application* of data or knowledge that makes it useful and changes it into information.

The JBS is much like a big pipe. Ideally, it is a means to get a lot of data to a place where it can be used, hopefully, in time for it to be useful. After this boat load of data arrives at its destination, there must be a way to quickly sift through it to find that which can be *applied*. Unfortunately, there are many obstacles that can get in the way. These obstacles can cause the information to be lost or become too outdated to be useful. Or it can become less effective because it is degraded by time or only some of it can be found.

JBS has seen a few real successes as well as some real disappointments. The effectiveness of JBS has been limited due to several factors that are discussed in this chapter. We will then look at what kind of overall effect the JBS has had on the decision making process of Operation JOINT ENDEAVOR and the operation itself.

A. LIMITATIONS TO JBS EFFECTIVENESS

Planning for Operation JOINT ENDEAVOR began without much thought toward the use of a direct broadcast satellite capability, because it was a technology that was not yet fielded. Many things followed this initial, unavoidable oversight that limited the effectiveness of the JBS and the amount of use it received. Nearly all of the limiting factors discussed below have their genesis in the lack of an integrated planning effort due primarily to the short timeframe from receiving the deployment order and JBS becoming operational. Although this thesis deals specifically with JBS, many of these limiting factors apply to other technology insertion programs that are rushed to the field as well.

1. Demonstration

The JBS was begun as an Advanced Concept Technology Demonstration (ACTD) program in an effort to use the 'only war in town' to test some of the capabilities of this new technology and develop lessons learned for future application. In most cases an ACTD is approached somewhat cautiously by fielding only a few systems for use. Because of the visibility of GBS and broadcast technology, this JBS capability was thrown together and very quickly sent to the European Theater. Funding for this effort was received on 22 January 1996. The first JBS receive suite was deployed less than two months later and the JBS was declared operational less than 3 months later (6 April 1996). In less than ten months 33 JBS receive suites had been deployed. Commanders often felt as if technology insertion programs were being 'shoved down their throats' and felt left out of the coordination loop with regard to JBS deployments. In fact, after the installation of JBS receive suites at ARRC and IFOR Headquarters in Bosnia, in August

1996, there were complaints that nobody knew the systems were coming and therefore nobody knew how to use or exploit the systems [Ref. 29].

2. Training

Because the required equipment was fielded and deployed very quickly there was no time to accomplish any real training of personnel on how to use the system. This caused a major lack of familiarity with the system and its capabilities as well as the associated lack of training. The lack of familiarity with the JBS and its capabilities left almost no advocates of the JBS system in the field to show commanders and other users the benefits and potential of the system. The lack of training was a critical issue. A BC2A mobile training team was established in the summer of 1996 to meet some of these deficiencies, however the training course did not cover JBS [Ref. 30]. In some cases, this led to the equipment being physically turned off because commanders did not want to invest the time necessary to get personnel trained in a haphazard, on-the-job fashion.

This training problem was exacerbated by frequent personnel rotation. Most people working at the JBS sites are TDY augmentees on a 60 or 90 day rotation. People rotate in and out so often it is difficult to maintain the 'corporate knowledge' of the system, how it works, the units the equipment services, what capabilities it provides, and how it benefits the users. The equipment is not especially difficult to use but there are many peripheral issues associated with the operational environment that greatly help or hinder the effective use of the JBS, dependent upon the knowledge of the people that are assigned.

> Many of the new systems and technologies were deployed without doctrinal support or concepts of operations. As a consequence, they could

> not be fully employed. Moreover, . . . trained military operators were not available. . . . In many cases, this meant that new systems were underutilized because their full functionality and potential were not understood. [Ref. 24]

3. Logistics

Another area that created many problems, especially in the early days of the operation, was the lack of a logistics trail. Since the JBS was fielded as a demonstration system no real planning was given to providing maintenance and equipment spares (in spite of the fact that it was going to 29 sites). A TDY JBS augmentee on a 60 day rotation wrote in his trip report, "Logistical support for hardware and software is extremely slow and unreliable. . . . Inadequate parts cause the system to be shut down and unavailable until new parts arrive, sometimes several days later" [Ref. 31].

4. Other Views

As with any other subject, there are always people with views on JBS that differ from your own. In the Multi-National Division (MND) environment in Bosnia this is true not only of individuals but of nations and other organizations as well. As mentioned in a previous chapter, some nations do not like to share information, but others do. The various militaries generally prefer more control over information, the United Nations along with other political and public organizations prefer fewer restrictions. All of these differing viewpoints led to limits on how much the JBS was used and how far the available information was disseminated.

> The usage level varied from site to site with the British and French MNDs at Banja Luka and Mostar not really using it . . .Other sites such as the ACE Rapid Reaction Corps at Sarajevo . . . and the 1st Armored Division at Tuzla used it more . . . . [Ref. 12]

> . . . with more than 30 different nations participating, there was a significant challenge to merge the cultural differences to achieve unity of effort and avoid "cultural clashes." [Ref. 24]

Additionally, because no specific units (e.g., intelligence or operations) have been given responsibility for, or 'ownership' of, the equipment it is treated differently at nearly every site. This lack of formal ownership lets nearly every group possible have their own views as to how the system should be used and provides no specific guidance to eliminate the disagreements.

5. Lack of Dissemination

Although "the deployed high technology systems generally supported the headquarters far more effectively than they supported the soldier on the ground . . ." [Ref. 24], it is generally the people below the headquarters level that can best use most of the information available. Because of cost and maturity of technology there were only a limited number of sites that could receive the JBS equipment. This rightly ended up being those locations that had the personnel, best power sources, and best connectivity to other systems. Thus, almost by default, they were placed at headquarters locations. Commanders and their staffs do make use of the information available, but generally it is not available to the lower echelon soldier.

> . . . life in Bosnia has not changed very much for the American soldier, because the information revolution largely stops at Division level. Despite the techno-hype, subordinate brigades and battalions typically conduct operations much as they did 20 years ago . . . . [Ref. 27]

Units below the Division or headquarters level often do not have access to the local area networks (assuming the JBS is integrated into the local systems), computers, or printers to allow them to effectively use the information if they could get it. There are also no documents or guidance that I have been able to find that discusses the distribution of JBS products. In most cases, if users don't work at the JBS equipment site they either don't know the system is available or they experience long delays getting the information they need, thus decreasing the value of the information.

6. No Integration

There are three specific locations (USS LaSalle, CAOC, and Tuzla) where they have integrated JBS into their LAN and have been able to (with various degrees of success) get broadcast products directly to the user's desktop. These three sites would be great examples of how to integrate the JBS because, unfortunately, they are the exception and not the rule.

Although the GBS program requirement is to be fully integrated into the DII, one of the biggest obstacles to effective use of the JBS is that its receive equipment suites are usually physically separated from and/or not integrated into locally existing networks. Two primary reasons for the lack of integration at receive sites is the lack of floor space and the fact that "Because the system has no formal testing, and was essentially thrust upon many of the users, it is not trusted" [Ref. 31].

The lack of floor space is often due to the deployed field conditions. All of the JBS equipment (although not a large amount) had to occupy whatever space was available since it arrived after UN forces were already in place. Additionally, some sites had to put their equipment in tents or other luxurious military shelters.

The lack of formal testing is an issue that will continue to concern users. This should be somewhat alleviated when the system passes accreditation testing, but probably won't be eliminated until the software baseline stabilizes, the information management tools are in place, and personnel are fully trained on the system.

This lack of integration does not only apply at the receive sites, but at the transmit sites as well. Because of lack of floor space and physical separation of the equipment, transmitting information over JBS (from JAC Molesworth) has, until recently, required dumping the files to a tape, physically taking the tape to a different building, downloading the files to the BC2A equipment, and then sending the information to the JIMC for uplink to the satellite for broadcast [Ref. 12].

Due of the short deployment timeline for JBS and because it is a operationally deployed developmental system (supporting the GBS demonstration phase), the JBS is and probably will remain a stovepipe system in spite of the many advances and improvements made over the last 16 months.

The integration problem is not just a hardware/location problem. It involves overcoming attitudes as well. This is well illustrated by the following:

> One of our significant challenges is to integrate BC2A to best support the MNDs. . . . If we are serious about integrating BC2A into these MNDs, the cost is an augmentee that has the rank of major or higher. This rank is required for access to the decision makers to fix the current site configuration. It takes time and effort to persuade the MNDs to position their components in the optimal locations. The MNDs will utilize the system to its potential only when the components are in the right place. Until we succeed in this endeavor, we will have difficulties maximizing the capability of the system. [Ref. 25]

Because of the problems with support, training, and integration, the cartoon shown in Figure 12 began being passed around to depict, although somewhat cynically, the level of frustration with the initial JBS capabilities.

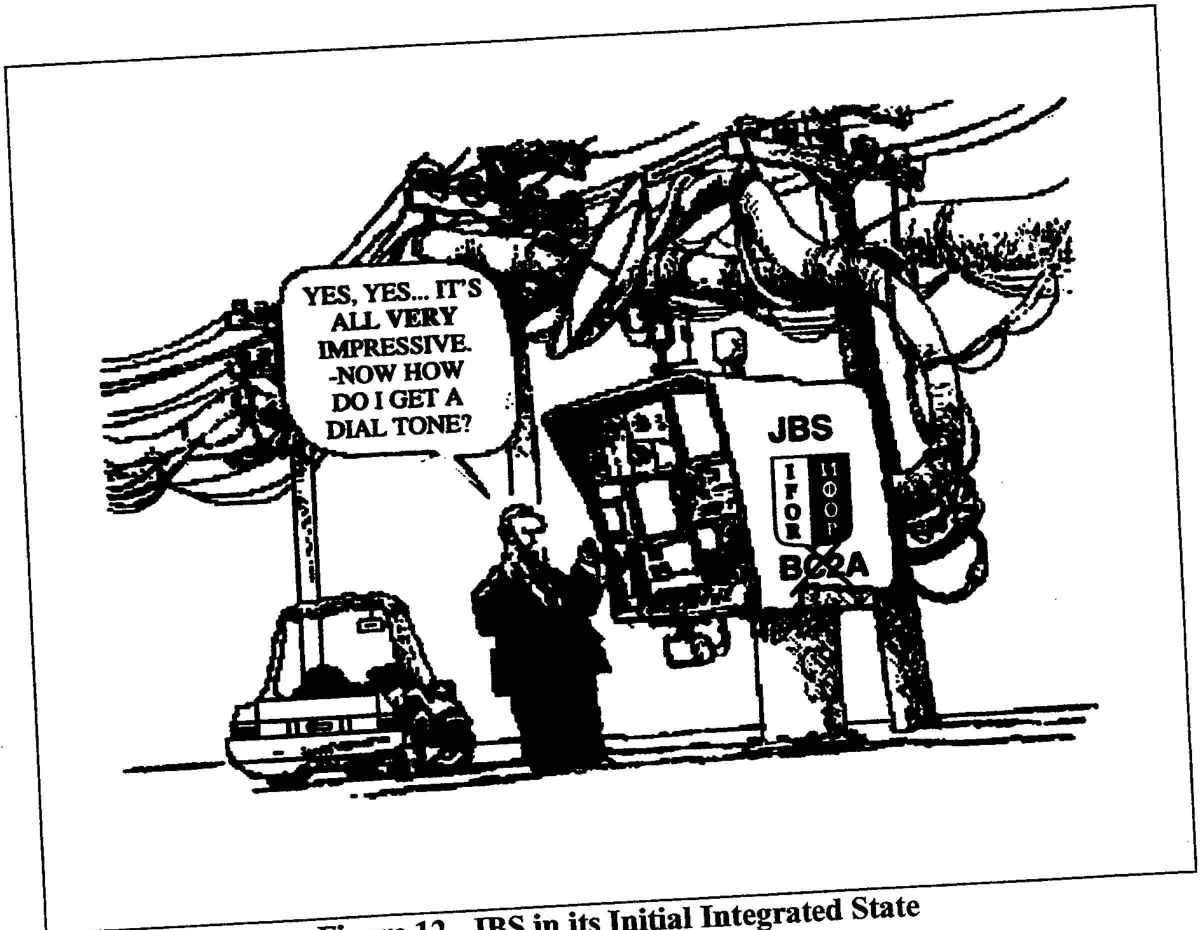


Figure 12. JBS in its Initial Integrated State

7. Security Concerns

In a UN operation involving over 30 nations it is easy to imagine the rampant worry about classified information and who has access to the information. Modifications were made to the JBS after the initial installations to allow it to pass all classification levels up to and including SECRET. Security managers were very wary of this since the JBS had undergone no formal testing. And, in spite of all the efforts to protect classified information on the JBS, there were many instances of security 'incidents.'

> Data sent from the BMC is incorrectly identified and classified. Often, map and HTML files were wrapped and sent as SECRET or CONFIDENTIAL but were not. Imagery that was SECRET REL NATO

was sent as UNCLASSIFIED and was not identified as classified until the annotation on the actual imagery was read. [Ref. 31]

8. Reliability

For the JBS system to be used effectively it must be viewed as a reliable method of receiving and exploiting information. When dealing with equipment, reliability is most often associated with a physical capability. It is also a trust that is developed between the user and the system. The following quotation graphically depicts the reasons for some of the frustrations associated with the JBS system as late as October 1996. These types of problems hit at the very heart of system reliability and must be solved for the system to be trusted and used.

> . . . I was surprised at the number of ways a product could get "detoured" once it entered the JAC. Put in a wrong piece of header data . . . and the user will not be able to pull up what he needs . . . because the query will not recognize it . . . Once the information is in the server . . . it isn't readily apparent which piece of information is most time-sensitive and critical. . . . it has to pass through a singular point of failure, the router at Ft. Belvoir. Surviving this, it has to pass through the JIMC queue . . . The "queue" failed on several occasions to broadcast the entire tape and in several instances appeared to have not operated properly with respect to precedences. . . . Once it has been broadcast, the JBS receive stations . . . must have available [disk] space . . . or all the information will be dumped . . . and . . . there is a good possibility . . . the crypto will have dropped synch. [Ref. 32]

In June 1996 members from the Defense Science Board visited the JBS site in Sarajevo. While there they conducted a small experiment.

> The DSB submitted a request for a specific product over various architectures. JDISS provided the product in 5 minutes, LOCE in 30 minutes, and by the time I had left it had been over 48 hours and the product had not yet arrived nor had there been any specific feedback regarding the request that had been submitted to the JIMC . . . [Ref. 33]

Several months later during an informal test conducted in October 1996 a set of 52 2-4 Mb files were sent over one of the daily broadcasts. Only 26 of those files were received by the broadcast. These 26 files trickled in over a one hour time period. This is not necessarily indicative of the JBS' normal performance but definitely points out a problem that must be solved. [Ref. 32]

9. Information Management

This topic was covered fairly well in the previous chapter and will not be reproduced here except to reiterate that information management tools are a *necessity* to prevent information overload and to make sense of the boat load of data received.

B. EFFECTS ON THE DECISION MAKING PROCESS

Since there are decision making processes from very high up to very low levels in the command chain, this section will briefly discuss the impact at very high levels in the decision making process. The impact at mid and lower levels will be mentioned in the next section discussing the effect of JBS on operations.

In most cases, decision making at the very high levels in Bosnia and the European Theater was relatively unaffected by the presence of JBS and its big information pipe. It was viewed as an unreliable demonstration system that was in theater more for the "gee-whiz" factor than anything else [Ref. 26]. Commanders and other decision makers at this level did not care how they got the imagery or information they needed as long as they got it when they needed it. JBS was just another pipe, not something to get real excited about.

There were two incidents, however, in which the video dissemination capability of the JBS was very useful and may have impacted some high level decisions. The first is known as the Hans Pisjak incident. On 5 July 1996 armored vehicles began rolling out of cantonment areas. Real-time video links (over JBS) from a Predator UAV were used by commanders to closely monitor the situation. This greatly enhanced the distributed collaborative planning that was taking place in response to this situation. A similar incident occurred at Mostar on 11 February 1997.

C. EFFECTS ON OPERATIONS

As should be expected of a demonstration system and one that is on the leading edge of technology, the JBS has not had an earthshaking effect on operations, but it has had a positive effect. The effect of the JBS on decision making and operations at the low levels of the command chain has been minimal because, as previously stated, units below the Division level usually do not have direct access to JBS receive suites. However, the middle levels (MND headquarters level) in the command chain have seen a larger impact than anywhere else, although this is still very site-specific because of the issues presented above as well as the missions of the units at those sites.

The largest positive impact of the JBS is primarily due to the faster delivery of imagery used for operational planning purposes. Photography, and other imagery, often has to be compressed to allow delivery by electronic means. Now, with JBS, it can be delivered faster at much lower levels of compression which helps maintain better resolution and quality. Maps and other very large files, which in the past had to be delivered by mail or courier and could take up to several days, can now be delivered in a matter of minutes. As mentioned above, the real-time distribution of video can also be very important to an operation.

Although the impact of the JBS on JOINT ENDEAVOR operations may seem minimal at this point, we must remember that the JBS is just getting started. JBS is getting easier to use and is achieving user acceptance. The demand for broadcast services continues to grow as well. The JBS *will* be a very useful and capable system but, unfortunately, it will be fighting an uphill battle for quite some time just to overcome many of the first impressions that were left over from its initial months in operation. When these initial impressions are overcome and the system matures and stabilizes the JBS will be a force multiplier by helping to provide information dominance on the battlefield.

VI. THEATER INJECTION CAPABILITY

The DoD's overall goal for the GBS is a single comprehensive system that provides worldwide high bandwidth coverage. To help accomplish this goal the military plans to use two types of uplink facilities: the Primary Injection Point (PIP) and the Theater Injection Point (TIP). The PIP is a fixed facility that uplinks source information into the broadcast system for receipt by users within the footprint of a particular satellite. The TIP is a transportable system located ashore or afloat that "includes transmit broadcast management and transmit uplink capabilities necessary to accept, coordinate, package, and to transmit vital CINC/CJTF/component directed in-theater information" [Ref. 28]. This chapter will discuss the specified requirements for the theater injection points, the difference between virtual theater injection and theater injection, and what has been done with regard to TIP development.

A. INJECTION REQUIREMENTS

The development of a theater injection capability is driven by a one sentence requirement in the Joint Mission Need Statement which states, "GBS should provide the capability for CINC and CJTF theater injection of information onto the broadcast" [Ref. 3]. The JORD goes into some specific detail on requirements for the TIP, including the following minimum requirements [Ref. 28]:

- Be capable of uplinking 6 Mbps with a 93 percent assurance of continuous connectivity

- Be capable of uplinking to the UFO GBS satellite (Ku band)
- Be capable of operating in 45 mph sustained winds and 60 mph gusts with

blowing sand, dust, or snow.

These minimum requirements will be used to assess on a pass/fail basis whether or not the TIP will support the operational needs of the warfighter. The first two requirements above have additional 'objective' requirements, or goals, beyond the minimum required. These TIP objectives include uplinking 24 Mbps with a 98 percent assurance of continuous connectivity and being capable of uplinking to a leased commercial satellite (Ka band) for GBS augmentation [Ref. 28]. Several other requirements are specified in the JORD but they deal primarily with the actual physical design of the TIP and won't be discussed here. Once these requirements are met and an operational TIP is fielded and in place, it will provide the commander with the ability to directly inject information from theater sources onto the broadcast.

One point of debate is whether or not the TIP requires an actual uplink capability or just a method to get information on the broadcast. The second requirement stated above seems to imply a required uplink capability, as does the one sentence requirement in the MNS. But, the JORD tends to negate that implication by stating that the ability to "broadcast real-time and near real-time in-theater source information . . . may be accomplished by either the TIP or by virtual injection" [Ref. 28]. This seeming conflict in requirements has sparked serious discussions but will probably only be settled after a detailed cost analysis is completed, the Joint In-Theater Injection (JITI) terminal (the TIP prototype) is fully tested, and it is determined which side has the most political backing.

To actually inject information on the broadcast requires communications connectivity from each information provider (source) to the appropriate injection point. Although the JBS has the Theater Injection Site (TIS) located at RAF Molesworth, UK, it has only one *uplink* site, the PIP (co-located at the Pentagon with the BMC). This requires that all information to be broadcast must be sent to the one uplink site by satellite, telephone, teletype, internet, or whatever means is available. In the case of JOINT ENDEAVOR operations, information derived from theater sources is sent to the TIS. From there the information is sent to the PIP via the DISN-LES where it is subsequently added to the queue for a future broadcast. Thus, the current theater injection site has what is called a 'virtual injection capability' as it cannot provide a direct uplink to the satellite. For purposes of this chapter I will use TIP to refer to a true theater injection (uplink capable) point and TVIS to refer to a Theater Virtual Injection Site (not uplink capable).

B. VIRTUAL INJECTION VERSUS UPLINK

As stated above, source information providers must transmit their information to either the TIP or the PIP for subsequent broadcast. In many cases (e.g., the European Theater and Bosnia) the source providers may be thousands of miles away from the PIP and may even be located in the Area of Operation (AO), such as Predator and combat camera units (see Figure 6).

1. Virtual Injection

For the European Theater, 'virtual injection' requires sending the source information to the TVIS and then from the TVIS over communications links thousands of miles back to the PIP only to be rebroadcast back into the European AO. This is a very inefficient use of the communications links. Whether or not it is more cost effective or desirable than putting an uplink capability in theater is another subject that will not be discussed here.

There are two distinct advantages to having a virtual injection capability instead of a true injection capability. First, and most obviously, there is the possibility of a substantial cost savings to the DoD by not putting time and money into the design, development, production, and fielding of the TIPs. Secondly, there would be no logistics requirements to transport, maintain, repair, and protect the TIP while it is in theater.

Figure 13 portrays the numbers of communications links, and the distances those links must cover, to support a theater virtual injection capability. In this example with two satellites, each satellite would have a separate PIP. To send the same information to both satellites for broadcast would require twice as many communications links since the information would have to be sent over separate links from the source to each TVIS and from there to each PIP, or to each PIP directly.

2. Theater Uplink

A theater uplink only requires sending the source information to the TIP. From there it will be directly uplinked to the satellite to be broadcast back into the theater. This is a much more efficient use of the communications links. Once again, whether or not it is more cost effective or desirable than using a TVIS is another subject that will not be discussed here.

A true injection capability has several distinct advantages. First is the cost savings to the DoD by not having to lease commercial long distance circuits (to include trans-oceanic and satellite links). This can be a substantial savings when you consider that the cost to lease a single Intelsat 3 transponder (for VSAT) is an "annual ~[six million dollars]" [Ref. 23]. Second is the ability to inject information directly without the increased possibility of errors due to the transmission through the many necessary lines,

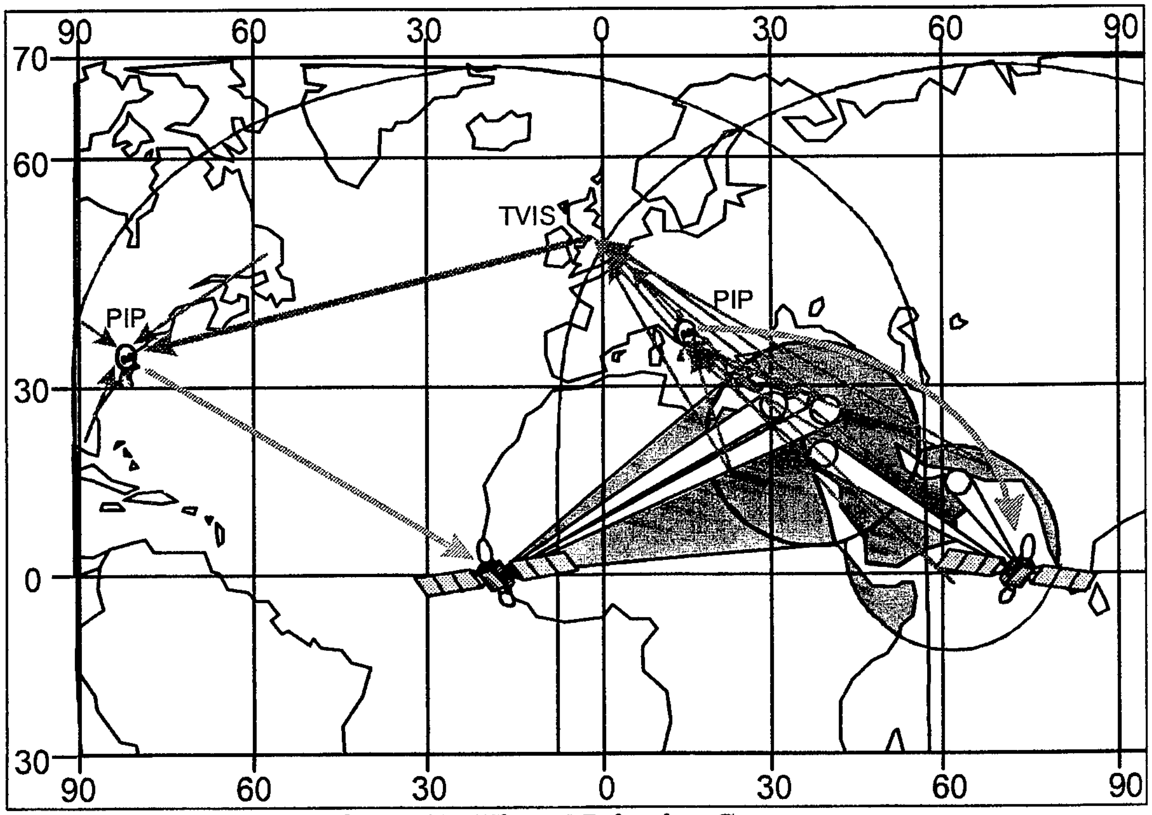


Figure 13. Virtual Injection Concept

repeaters, switches, and facilities. Third is that the theater uplink capability would still exist if the PIP is shut down (a limited backup capability). Conversely, if the TIP was shut down the broadcast from the PIP would still be available, as well as the possibility of getting critical theater information to the PIP for subsequent broadcast. Lastly, in many areas of the world good wideband communications to the TIP would be easier to get, from theater (organic) assets, than the necessary wideband communications from the TVIS to the PIP.

Figure 14 portrays the numbers of communications links, and the distances those links must cover, to support a theater injection (uplink) capability. In this example with two satellites, each satellite would have a separate PIP. However, each satellite would also be able to accept an uplink from up to three TIPs, which can be shared between the satellites as long as the TIP is in the view of the satellite [Ref. 28]. To send the same information to both satellites for broadcast would require communications links between the TIPs, sharing uplink time between satellites (depending upon the criticality of the information), or communications links from the information sources to each TIP. Figure 14 depicts the second option with each satellite being supported by multiple TIPs. This arrangement also leaves the option open to directly send the information to the PIP if necessary.

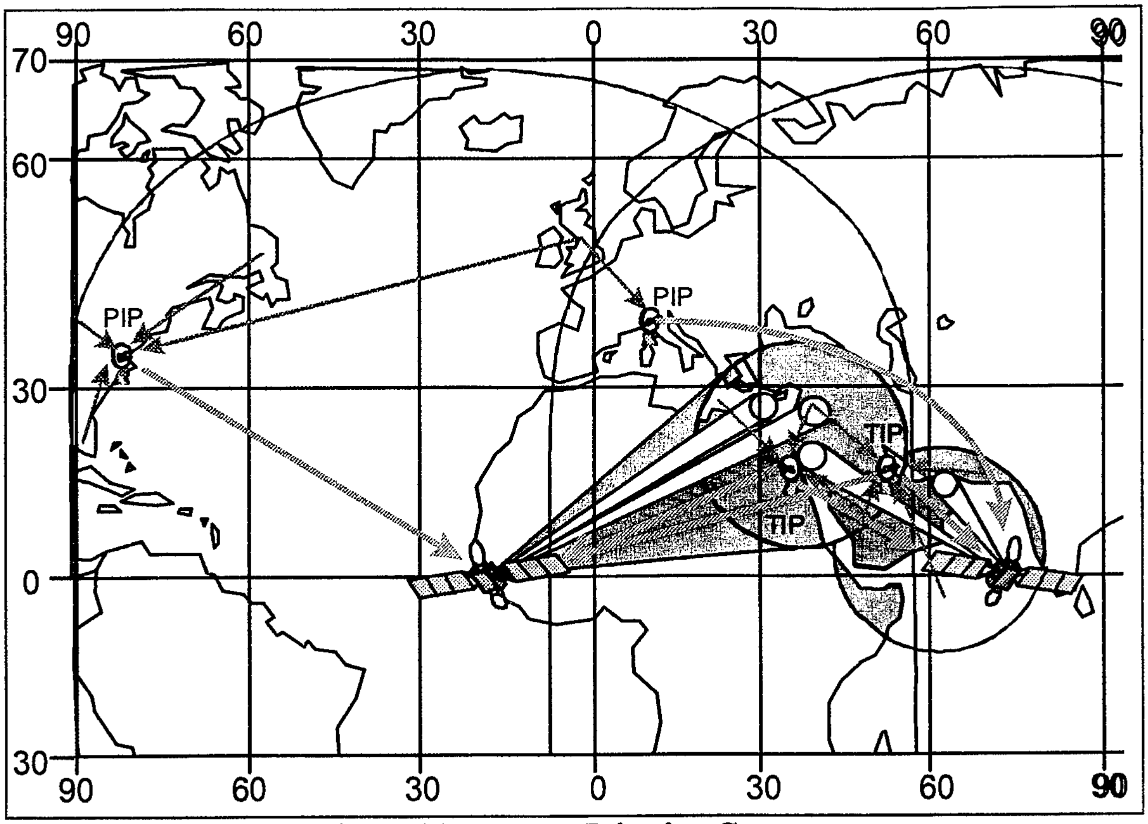


Figure 14. Theater Injection Concept

C. TIP DEVELOPMENT EFFORTS

As defined earlier in this chapter, the TIP is a transportable system with the capabilities necessary to handle broadcast management and to accept, coordinate, package, and uplink information from within the theater to the JBS satellite for broadcast back into the theater. The JITI terminal is the only system designed as a testbed to provide proof of concept demonstrations and technology experiments" [Ref. 34].

The JITI design and construction effort was led by the U.S. Army Space Command and supported by the Army's Communications-Electronics Command (CECOM), the Army's Battle Command Battle Lab - Fort Gordon, and the Air Force Communications Agency (AFCA). It was based on the requirement in the GBS MNS and the hypothesis that "If a theater commander is allocated satellite communications throughput and an organic ability to inject information directly into a satellite for broadcast to his deployed forces, then the lethality of his forces is improved" [Ref. 35]. It has been used extensively during the GBS Phase I CONUS Testbed operations and was demonstrated during the Joint Warrior Interoperability Demonstration (JWID) 1996.

1. JITI Configuration

The JITI is housed on a 21 foot trailer that contains a seven foot by seven foot shelter for equipment and personnel. The trailer also accommodates a 3.7 meter tracking antenna, generator, and an environmental control unit as shown in Figure 15. Separate from the trailer, but required for operation, is an Uninterruptable Power Supply (UPS). This configuration has been C-130 certified and meets the requirement for transportability on one C-130 aircraft. A forklift is required to move the UPS and a 5 ton mover is required for the trailer.

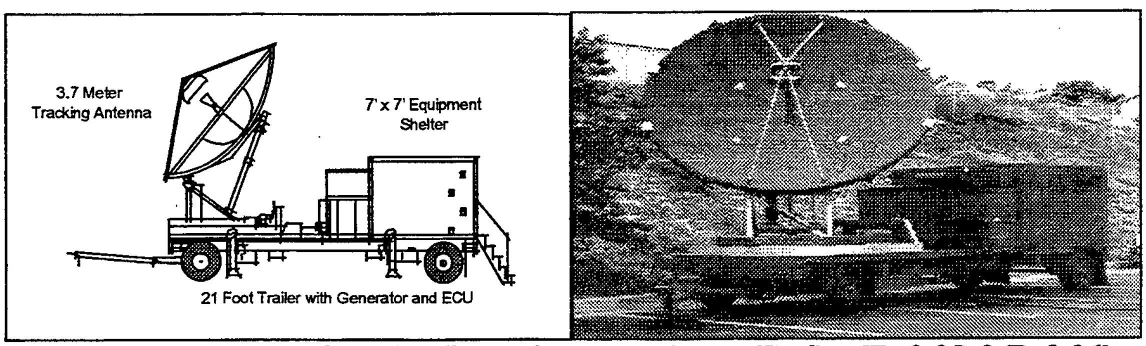


Figure 15. JITI Terminal Configuration on a 21 Foot Trailer [Ref. 35 & Ref. 36]

The JITI was designed using COTS equipment and technology as much as possible. It utilizes the on-board generator or commercial power and operates in the Ku frequency band. The tracking antenna helps during initial acquisition of the satellite and, if necessary, during satellite changes by tracking off of the beacon signal emitted by the satellite. The Signal Entry Panel provides the interface to outside sources and can handle fiber optic cable, two telephone jacks, two video channels (six inputs), and two additional equipment connectors (for future UAV connections). Bulk encryption for broadcast is done by a KG-194A.

2. JWID 96

"The primary demonstration goal for the JITI terminal during JWID 96 was to show the ability to simultaneously inject information products from both Theater information sources through the terminal and Regional information sources through the PIP" [Ref. 34]. The JWID 96 configuration is shown in Figure 16. Most of the information products for broadcast were provided by a LAN connection to the Army Digitized Tactical Operations Center (TOC) and telephone connectivity was maintained between the JITI and the PIP so users could work from a consolidated program (channel) guide [Ref. 34]. The primary JWID goal was met with the JITI broadcasting video and encrypted data while the PIP was simultaneously injecting other information products.

After the JWID 96 demonstration the JITI was moved to CECOM at Fort Monmouth, NJ, to take over operations as the GBS CONUS Testbed uplink facility while the GBS testbed at the Naval Research Laboratory (NRL) was moved to the Pentagon. It operated as the testbed from September 1996 to March 1997, after which it was upgraded and an Asynchronous Transfer Mode (ATM) capability added. The upgrade gives the JITI the capability to uplink 1 classified and 1 unclassified data channel, 4 video channels, and 1 ATM channel. This new capability was used to support testing for the Battlefield Analysis and Data Dissemination (BADD) program as well as other demonstrations. Additional funding is being sought to make the JITI dual band capable (Ku and Ka).

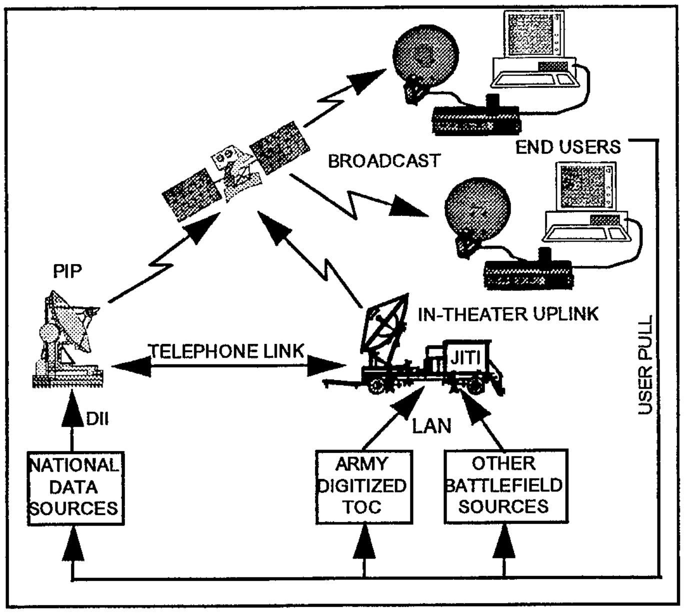


Figure 16. JWID 96 GBS Configuration [Ref. 34]

Development of a second prototype will be left to the contractor that wins the contract for GBS Phase 2 which has not yet been announced. The design plans and lessons learned from the JITI will be provided after contract award to ensure a sound design with as little rework as possible. Because of the delays on getting the GBS Phase 2 contract awarded, the JITI may still support Phase 2 of the GBS program and could provide a TIP initial operational capability (IOC) to meet the Phase 2 requirements with the UFO/G satellites that will be launched beginning in early 1998. The JITI may also act as an Interim Injection Point and serve as a temporary operational uplink to the UFO/G satellites at the designated PIP sites until the PIPs become operationally available [Ref. 37].

VII. LESSONS LEARNED, CONCLUSIONS, AND RECOMMENDATIONS

History should have taught us that there is never enough available communications. The story of the soldier in Grenada making a personal credit card call back to headquarters on a public telephone will be etched in military history books forever as a grand example of how interservice parochialism and stovepipe C4I systems lead to a lack of communications interoperability that adversely affects a battlefield. Desert Storm taught us another hard lesson about how inadequate our communications capabilities are when compared to what we think we need. We have learned. We have improved our interoperability and our capabilities, but we can never get enough bandwidth.

The purpose of this thesis was threefold. The first purpose was to provide a brief history of the commercial DBS technology and outline the basics of the Global Broadcast Service as a basis for discussion. The second purpose was to provide an in-depth look at the JBS in Operation JOINT ENDEAVOR, how it was used, how effective it was at providing a new capability for the warrior, and develop some lessons learned based on this research. The final purpose was to look at the theater injection capability from a high level and determine if it is a necessary capability. This chapter conveys some of my thoughts regarding the JBS and lessons learned from its use in Bosnia as well as my conclusions based on this research. Lastly, I identify a couple of areas that require further research.

As far as its performance as an operational tool, I think the JBS was incorrectly advertised as a panacea to solving the communications problems and many people and organizations expected perfection and immediate impact. Instead it has performed very well for the rapid reaction technology demonstration program it is. It has provided a capability for the warfighter to access information and products previously unavailable electronically or, in many cases, faster than otherwise available. Additionally, its operational use has provided many lessons learned that will be invaluable to the GBS program.

A. LESSONS LEARNED

I have grouped many of these lessons learned from its operational use into four broad categories and summarized them below.

1. Information Management

As technology improves and information can be passed at faster and faster rates we must realize that the detail, resolution, and amount of information available will also increase. Thus, regardless of the amount of information available to us, or the amount of data we can send each second, the key to the effective use of this information is information management. First, we must decide what types of information are critical and what are not (e.g., based on subject matter, time, or location) and establish levels of precedence that are standard throughout the DoD. Second, we must place restrictions on how much information is sent to our deployed forces that was not *specifically* requested by those forces. Lastly, we need to provide the hardware and software tools necessary to filter, sort, retrieve, and manipulate the information received quickly, in a user friendly manner, and at the location where it is needed.

2. Integration

After information management, the next biggest hurdle to effective use of information is integration. Both the transmit and receive sites *must* be integrated into the local networks. Not only will this make providing information management tools easier but it will make the system and its products available to the users where and when they need it. If information is not easily accessible or reliable it will not be used.

Additionally, the overall goal of the DoD's C4I for the Warrior concept is a single integrated 'infosphere.' Until the JBS/GBS is completely and effectively integrated into this infosphere (in this case specifically the DISN and DII) it will remain a stovepipe system and its effectiveness will be limited regardless of the products that it provides.

3. Training

Based on my research, many of the problems with the JBS (e.g., reliability, logistics, and security) could have been mitigated or avoided by providing an up-front comprehensive training program.

To effectively use the system there must be people trained and familiar with its capabilities. This should include, if at all possible, training from someone that has done the job, not just the systems engineers that developed the system. This training *must* be provided before the person arrives in the position where he/she is expected to operate the system.

A master user, or help desk, where users can go to get additional help quickly and whenever needed is also important. Many problems in Europe remained problems much longer than necessary because there was no support available after duty hours in Washington D.C. or on a weekend. If the system is operational 24 hours a day then the help desk must be adequately staffed 24 hours a day.

4. Planning

Proper planning for a rapid deployment, as is common among technology insertion and rapid prototype programs, is difficult at best. However, for any system deployment there needs to be a well thought out and coordinated plan. The plan needs to include information regarding where the equipment should be placed, how to integrate it into the local network, equipment spares and maintenance, and an overall training plan for the unit. The plan then needs to be implemented making sure each aspect is effectively accomplished. Sometimes it is better to incur fielding delays than to deploy the system before it is ready. The lack of a proper planning effort will negatively impact the user's perceptions of the system by not providing them the information needed to integrate it into their operational architecture.

5. Be Realistic

If it is a great program that is mature and expected to change the world then advertise it that way and go out and do it. But, be prepared for all of those things mentioned above.

If the program is in the developmental stages, on the leading edge of technology, and unfielded or in the rapid prototyping stage don't advertise it as a system that will change the world, and don't expect it to. Start out small. Test it at a few sites to get it working as desired before going ahead with a general deployment. And, be prepared for all of those things mentioned above (and more).

Many of the problems encountered by the JBS were due to the fact that it was a new system that was sent to too many sites, too fast, without enough planning and preparation.

B. CONCLUSIONS

The JBS is a relatively new system that was fielded rapidly to support Operation JOINT ENDEAVOR. It has provided many lessons learned that will benefit the BC2A and GBS programs as well as many others. Most of the issues identified in this thesis are being addressed as the JBS continues to improve and gain more user acceptance.

I began this research looking at the JBS as a new operational tool for the warfighter that would be a major player in providing Information Dominance. However, as I got deeper into my research I realized that the JBS is not a well developed system that was designed from the ground up for the military. It is a rapid prototype technology demonstration program and its *primary role* is to prove concepts and gain valuable experience to be applied toward the GBS program. Its *secondary role* is to provide a new tool for the forward deployed troops to use in their operations. Based on the results of my research, as summarized in this thesis, I determined that the JBS has performed its primary role superbly and its secondary role adequately. As the JBS continues to be used and improved the users will begin to recognize the capabilities it brings to the fight. The bottom line is that the JBS is not a panacea and does not solve all of our communications problems, but it is a definite success and will become one of our communications workhorses of the future.

Additionally, the use of a true theater injection point (uplink capable) will greatly enhance the effectiveness of the JBS/GBS by providing a theater uplink capability that can furnish the flexibility required in a military operation without clogging up the deployed forces long-haul communications.

These two capabilities together will prove to be a true force multiplier.

C. RECOMMENDED AREAS FOR FURTHER STUDY

This thesis presented the 'history' of the deployment and use of the JBS in Bosnia. With all of the lessons learned from this continuing experience in Bosnia the next logical step would be to take those lessons learned and develop a plan to implement the necessary changes in the JBS (BC2A) and GBS programs.

Because direct satellite broadcasting in a military environment is pushing the edge of the technology envelope, there are many other areas that could use additional study with regard to the JBS and GBS. There are two specific areas that I feel are important enough to mention here. These two areas are:

- **Technology Insertion Programs.** What can be done to more effectively handle technology insertion programs? How can they be better planned for? How can they be inserted without operational commanders feeling overwhelmed with 'good ideas?' Should there be a central clearinghouse for these programs? Should there be some minimum requirements that must be met before they should be deployed? What can be done to provide a smoother transition and better integration of these systems?

- **Information Management.** Is there a way to specify critical types of information? What types of information are most useful operationally (e.g., for air, land, and sea operations)? Can a DoD-wide precedence system be implemented? What doctrinal changes would be required to support a DoD-wide precedence system?

APPENDIX A. JIMC/JBS DETAILED REPORTS [REF. 39, 40, & 41]

JIMC UP TIME STATUS REPORT
WEEK ENDING 18 MAY 1997

	UP TIME	COMMENT
INFORMATION SYSTEMS		
SERVERS		
US Secret	100%	
Rel NATO	97.42 %	
COMM PIPES		
SIPRNet	100%	
DISN-LES	100%	
NATO NES TUNNEL	83.51%	1. 1700Z 12May - 1552Z 13May: Hardware failure on NATO IFL. 22hr. 52min. 2. 1303Z -1333Z 14May: Configuration error with NATO IFL. 30min. 3. 0910Z-1330Z 18May: Changed out Black IFL due to hardware failure.
BROADCAST SYSTEMS		
VIDEO		
AFRTS	100%	
CNN	100%	
UAV	100%	
Secure Audio	100%	
IP		
US Secret Gateway	100%	
Rel NATO Gateway	100%	
BINO US Secret	99.06%	1. 0940Z-1115Z 17 May: Software configuration error. 1hr. 35min.
BINO Rel NATO	100%	
TRAP	100%	
RDM US Secret	99.11%	1. 1620Z-1750Z 15 May IP SECRET file system error caused system crash. 1hr. 30min.
RDM Rel NATO	100%	
ATM		
US Secret Gateway	100%	
NATO Gateway	100%	
Video CNN HLN/DIN	100%	

JBS US SECRET IP CHANNEL STATISTICS

WEEK ENDING 18 MAY 1997

Product Classification	Number of Files
UNCLASSIFIED	4551
SECRET	754
RELNATO	2
NATO/SFOR	3
SECRET RELNATO	50
Total	**5360**

Product Priority	Number of Files
1 ("Flash")	1
2 ("Immediate")	247
3 ("Priority")	83
4 ("Routine")	4553

Product Type	Number of Files
ATO	1
GLOBAL CATALOG	1
ARMY INTEL DATA	1
JTAGS	1
BINARY	1
MESSAGES	1
TACTICAL AOB	1
INTEL PRODUCTS	2
TOMAHAWK MDU	2
MPEG	2
MAPS	2
CGS	2
ESD	2
GCCS COP	3
HTML	5
IMAGERY	5
EARLY BIRD	5
STARS & STRIPES	8
TEXT	48
NITF	74
GRAPHICS	87
UNKNOWN	161
IPA	194
SYSTEM	314
BC2A PRODUCTS	1016
WEATHER	3921
Total Number of Files	**5860**
Total File Size	**7.67 GB**

Product Delivery Date	Number of Files
12-May-97	1012
13-May-97	868
14-May-97	875
15-May-97	877
16-May-97	765
17-May-97	837
18-May-97	626

Selected Product Destinations	Number of Files
ALL	3924
BOSNIA	4305
STUTTGART	447
TUZLA	136
AVIANO	134
SARAJEVO	119
RAF MOLESWORTH	115
VICENZA	114
CAMP MCGOVERN	108
USS LASALLE	96
TASZAR	63

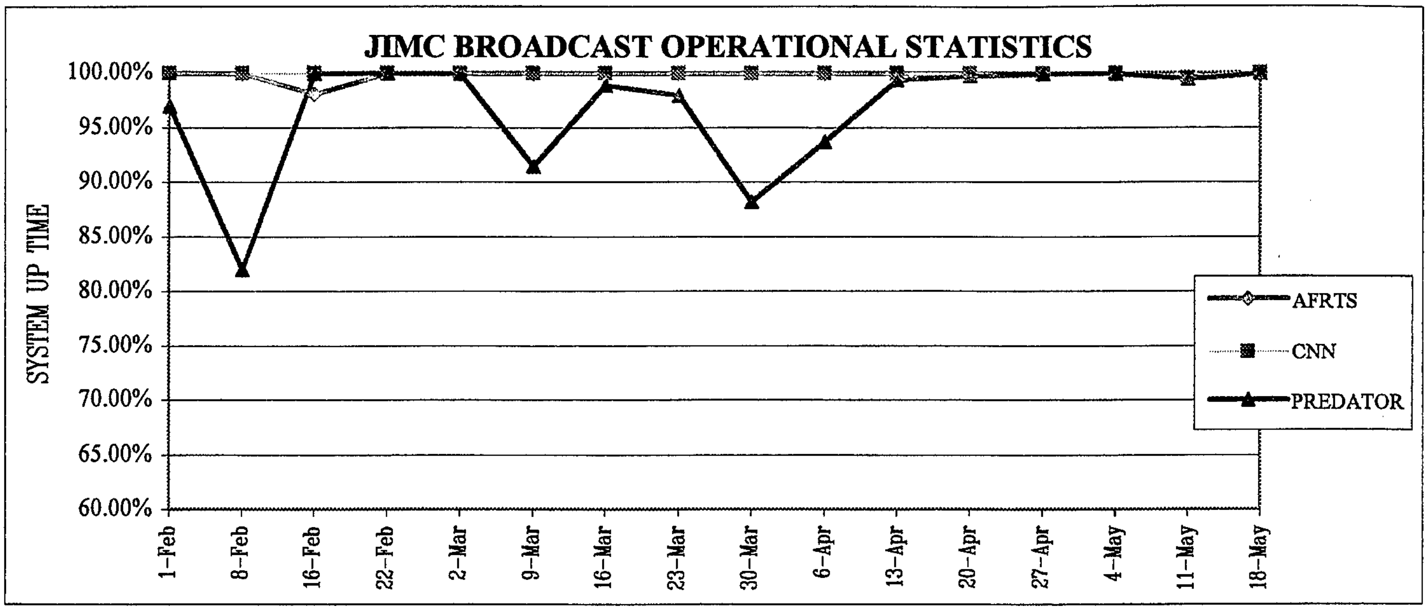
Product File Size (Bytes)			Number of Files
	<1		155
>1	and	<32	2
>32	and	<128	4
>128	and	<256	44
>256	and	< 512	47
>512	and	<1024	226
>1024	and	<2048	215
>2048	and	<4096	476
>4096	and	<8192	264
>8192	and	<16384	83
>16384	and	<32768	203
>32768	and	<65536	1707
>65536	and	<131072	730
>131072	and	<262144	301
>262144	and	<524288	781
>524288	and	<1048576	277
>1048576	and	<2097152	222
>2097152	and	<4194304	69
>4194304	and	<8388608	11
>8388608	and	<33554432	1
>33554432	and	<134217728	4
>134217728	and	<268435456	38

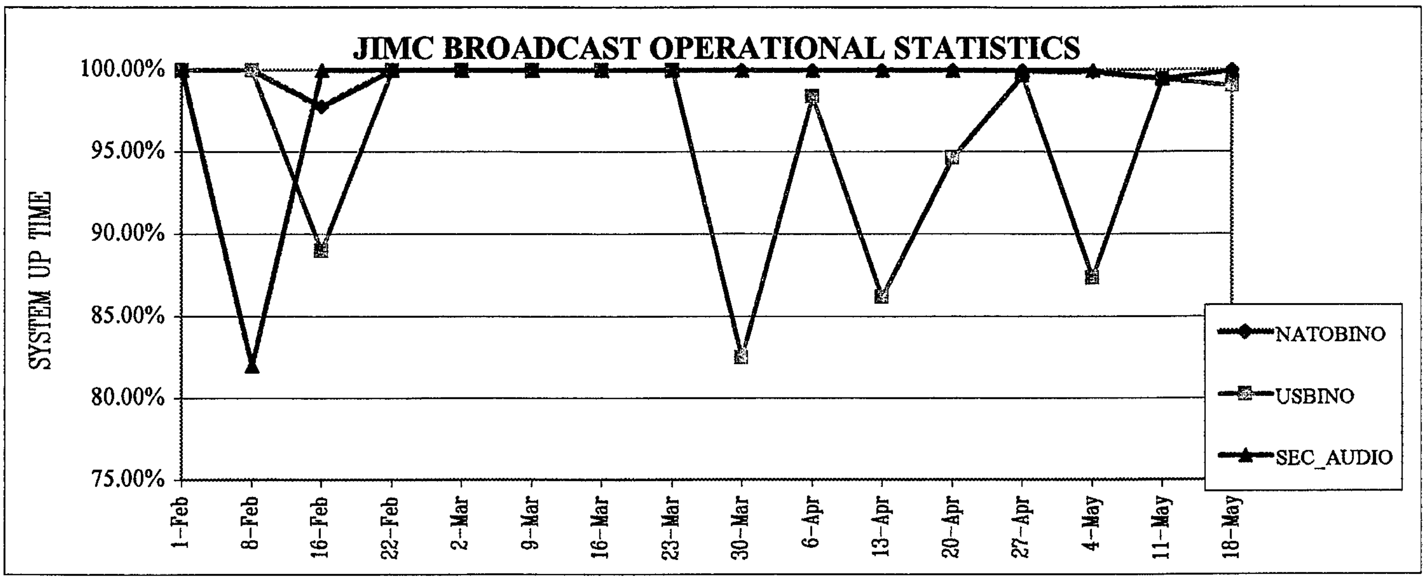
JIMC STATISTICS
FEB - MAY 1997

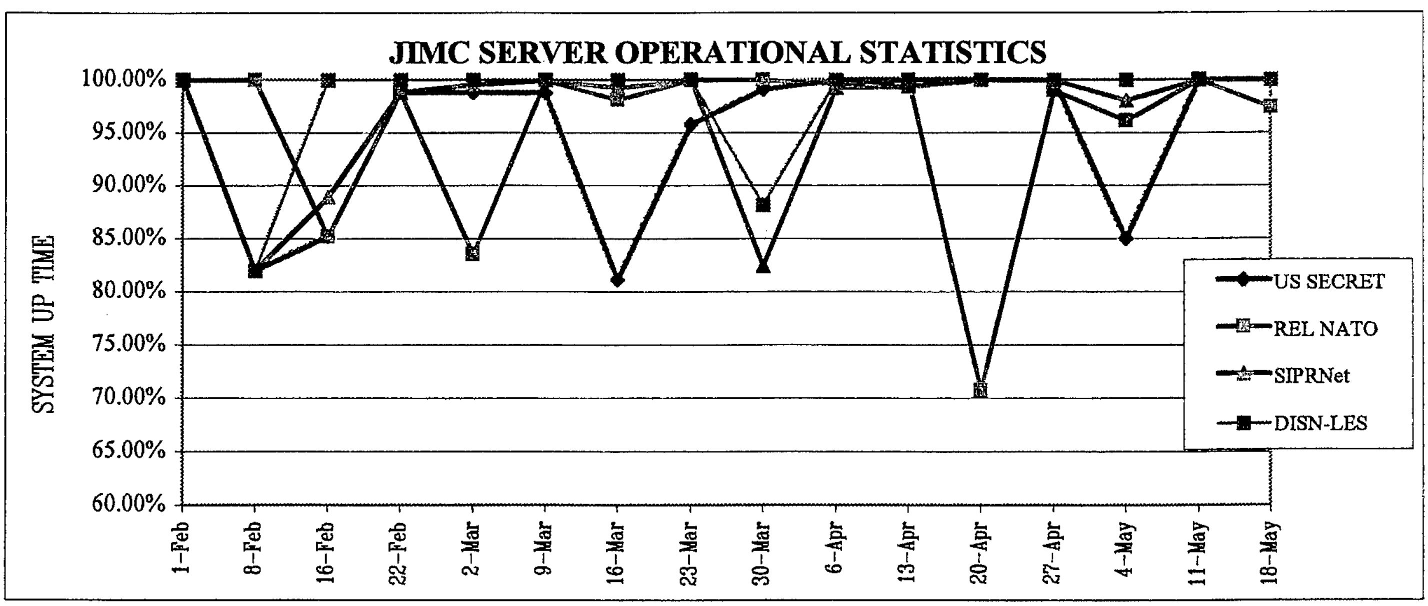
DATE	AFRTS	CNN	PREDATOR
1-Feb	100.00%	100.00%	97.00%
8-Feb	100.00%	100.00%	82.00%
16-Feb	98.11%	100.00%	100.00%
22-Feb	100.00%	100.00%	100.00%
2-Mar	100.00%	100.00%	100.00%
9-Mar	100.00%	100.00%	91.50%
16-Mar	100.00%	100.00%	98.95%
23-Mar	100.00%	100.00%	97.98%
30-Mar	100.00%	100.00%	88.20%
6-Apr	100.00%	100.00%	93.70%
13-Apr	100.00%	100.00%	99.40%
20-Apr	100.00%	100.00%	99.80%
27-Apr	100.00%	100.00%	100.00%
4-May	100.00%	100.00%	100.00%
11-May	99.50%	99.50%	99.50%
18-May	100.00%	100.00%	100.00%

DATE	NATOBINO	USBINO	SEC_AUDIO
1-Feb	100.00%	100.00%	100.00%
8-Feb	100.00%	100.00%	82.00%
16-Feb	97.76%	88.99%	100.00%
22-Feb	100.00%	100.00%	100.00%
2-Mar	100.00%	100.00%	100.00%
9-Mar	100.00%	100.00%	100.00%
16-Mar	100.00%	100.00%	100.00%
23-Mar	100.00%	100.00%	100.00%
30-Mar	100.00%	82.50%	100.00%
6-Apr	100.00%	98.40%	100.00%
13-Apr	100.00%	86.20%	100.00%
20-Apr	100.00%	94.64%	100.00%
27-Apr	100.00%	99.70%	100.00%
4-May	99.91%	87.35%	100.00%
11-May	99.50%	99.50%	99.50%
18-May	100.00%	99.06%	100.00%

DATE	US SECRET	REL NATO	SIPRNet	DISN-LES
1-Feb	100.00%	100.00%	100.00%	100.00%
8-Feb	82.00%	100.00%	82.00%	82.00%
16-Feb	85.22%	85.22%	88.99%	100.00%
22-Feb	98.84%	98.84%	98.84%	100.00%
2-Mar	98.80%	83.53%	99.55%	100.00%
9-Mar	98.80%	100.00%	100.00%	100.00%
16-Mar	81.16%	98.16%	99.30%	100.00%
23-Mar	95.78%	100.00%	100.00%	100.00%
30-Mar	99.10%	100.00%	82.50%	88.20%
6-Apr	100.00%	99.70%	99.30%	100.00%
13-Apr	100.00%	100.00%	99.40%	99.40%
20-Apr	100.00%	70.72%	100.00%	100.00%
27-Apr	100.00%	99.02%	100.00%	100.00%
4-May	84.97%	96.13%	98.09%	100.00%
11-May	100.00%	100.00%	100.00%	100.00%
18-May	100.00%	97.42%	100.00%	100.00%


JIMC BROADCAST OPERATIONAL STATISTICS
SYSTEM UP TIME
100.00%
95.00%
90.00%
85.00%
80.00%
75.00%
70.00%
65.00%
60.00%
AFRTS
CNN
PREDATOR
1-Feb
8-Feb
16-Feb
22-Feb
2-Mar
9-Mar
16-Mar
23-Mar
30-Mar
6-Apr
13-Apr
20-Apr
27-Apr
4-May
11-May
18-May


JIMC BROADCAST OPERATIONAL STATISTICS
SYSTEM UP TIME
100.00%
95.00%
90.00%
85.00%
80.00%
75.00%
NATOBINO
USBINO
SEC_AUDIO
1-Feb
8-Feb
16-Feb
22-Feb
2-Mar
9-Mar
16-Mar
23-Mar
30-Mar
6-Apr
13-Apr
20-Apr
27-Apr
4-May
11-May
18-May


JIMC SERVER OPERATIONAL STATISTICS
SYSTEM UP TIME
100.00%
95.00%
90.00%
85.00%
80.00%
75.00%
70.00%
65.00%
60.00%
US SECRET
REL NATO
SIPRNet
DISN-LES
1-Feb
8-Feb
16-Feb
22-Feb
2-Mar
9-Mar
16-Mar
23-Mar
30-Mar
6-Apr
13-Apr
20-Apr
27-Apr
4-May
11-May
18-May

JBS Availability
(1 - 31 October 1996)

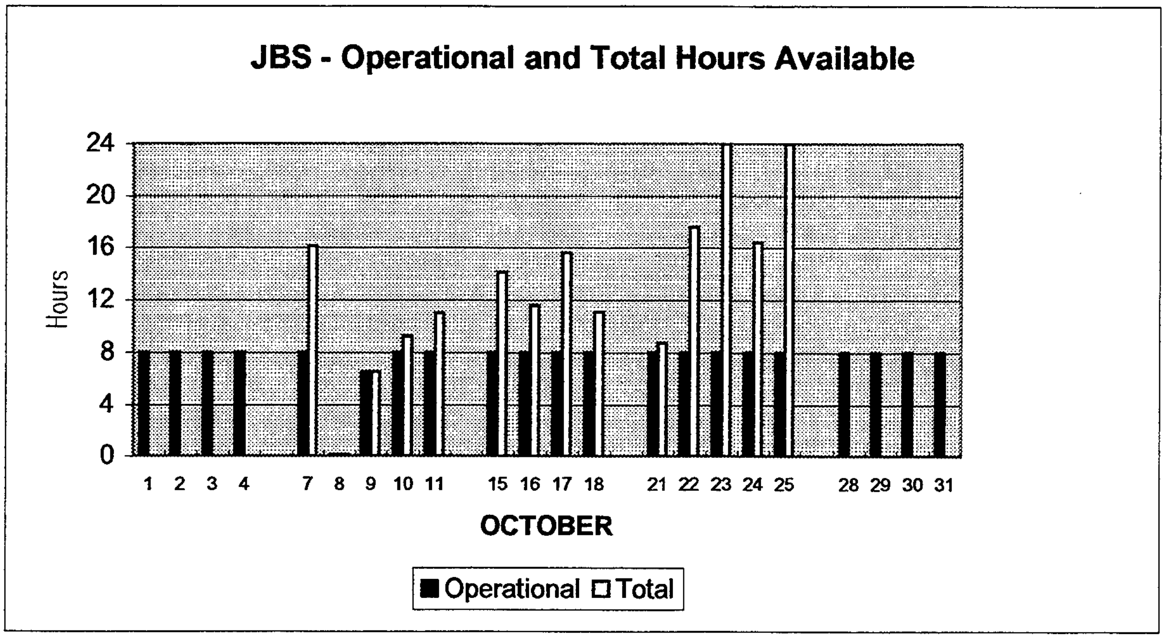
Date (Oct)	Operational Day (Hours)	IP Unscheduled Down Time (Hours)	Video Unscheduled Down Time (Hours)	Comments
1	8	0	0	
2	8	0	0	
3	8	0	0	
4	8	0	0	
5	0	0	0	No Report
6	0	0	0	No Report
7	8	0	0	
8	8	7.9	0	RDM inop-not saving files
9	8	1.5	0	RDM dispose file fixed
10	8	0	0	
11	8	0	0	
12	0	0	0	No Report
13	0	0	0	No Report
14	0	0	0	No Report-National Holiday
15	8	0	0	
16	8	0	0	
17	8	0	0	
18	8	0	0	
19	0	0	0	No Report
20	0	0	0	No Report
21	8	0	0	
22	8	0	0	
23	8	0	0	
24	8	0	0	
25	8	0	0	
26	0	0	0	No Report
27	0	0	0	No Report
28	8	0	0	
29	8	0	0	
30	8	0	0	
31	8	0	0	
TOTALS	176	9.4	0	

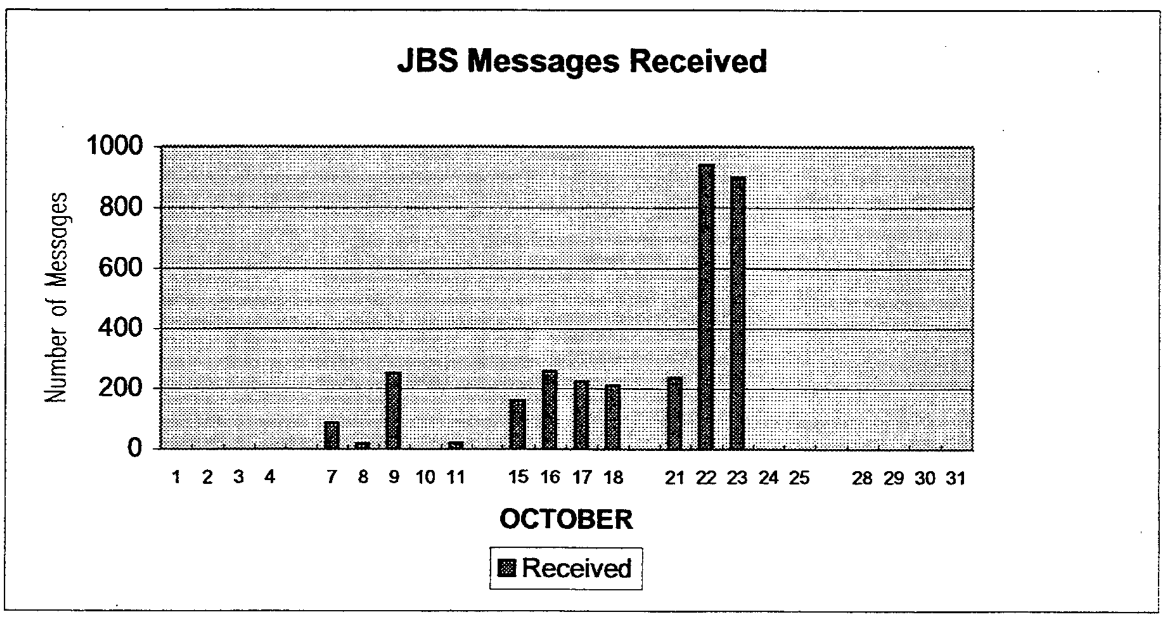
94.66%	100.00%
IP Available during Op. Hours	Video Available during Op. Hours

JBS Availability
(1 - 31 October 1996)

DAY	Operational	Total	Messages
	Hours Up	Hours Up	Received
1	8	N/A	N/A
2	8	N/A	N/A
3	8	N/A	N/A
4	8	N/A	N/A
7	8	16.1	86
8	0.1	0.1	16
9	6.5	6.5	251
10	8	9.25	0
11	8	11	20
15	8	14.1	159
16	8	11.6	256
17	8	15.6	224
18	8	11.1	209
21	8	8.75	235
22	8	17.6	938
23	8	24	898
24	8	16.4	N/A
25	8	24	N/A
28	8	N/A	N/A
29	8	N/A	N/A
30	8	N/A	N/A
31	8	N/A	N/A
TOTALS	166.6	191.1	3292

JBS Availability
(1 - 31 October 1996)





APPENDIX B. BC2A INFORMATION MANAGEMENT ANNEX

Annex D
Information Management

HQ USEUCOM J6
20 SEP 96

Authors

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Information Management Annex to BC2A Concept of Operations

D.1. Overview

D.1. 1 Purpose

The purpose of this annex to the BC2A CONOPS is to establish BC2A policies and procedures for information management (IM) to support USEUCOM theater commanders. The intent of the IM policies and procedures contained herein is to facilitate the flow of accurate and timely information to warfighters. While the focus of effort will be on supporting operational commanders, the BC2A is also capable of supporting logistics, intelligence, personnel, medical and other information requirements. BC2A can also reach other geographic areas as a means of sharing operational information with supporting commands and higher headquarters. This large capacity broadcast capability serves to provide video and large data files very quickly to one, a few, or all users in the satellite broadcast footprint.

Although some of the discussion in this annex may be related to system security, Annex G of the BC2A CONOPS provides BC2A system security policy and guidance.

D.1. 2 System Elements

Under the BC2A program, EUCOM will receive several new capabilities, including: satellite broadcast, via Joint Broadcast Service (JBS), of both streaming (video/audio) and packetized data, very small aperture terminal (VSAT) satellite networking, and large information servers with server-to-server interaction and associated advanced applications. These new capabilities will complement and eventually be fully integrated with existing networks and applications, such as SIPRNET, GCCS and Intelink-S. The information servers will be deployed to user sites and will be connected to a JBS terminal and, depending on configuration, other communications systems such as the BC2A VSAT network or SIPRNET. Sites with JBS broadcast receivers will be able to receive video and data. Video will be routed by the JBS to the video receivers and data to the information server. These sites will also be able to request special broadcasts to meet site information needs.

This annex focuses on JBS, primarily digital data broadcasts and to a lesser extent analog video. Concepts for VSAT use will be developed as the system matures.

D.1. 2.1 Terms of Reference

Development of this concept resulted in the application of several terms of reference. These terms of reference are key to understanding the IM concept of operations.

D.1. 2.1.1 Catalog - The catalog is a list of information products that are available to BC2A users. Product sources, such as Central Intelligence Agency (CIA), Defense Mapping Agency (DMA), higher headquarters, and/or users themselves, populate the catalog with meta data that describes products that can be accessed by BC2A users. The catalog, which is maintained by the Joint Information Management Center (JIMC), will be periodically broadcast to users over the JBS to be captured on their local server. Users can browse or search the catalog for specific products using search engines. Based upon review of the selected meta data, users can order the associated information product through SIPRNET, phone, or fax modes.

D.1.2.1.2 User Subscription - Users may receive all updates of recurring or periodic information products by subscribing to that product when placing a catalog order with the JIMC. Depending on the nature of the product, the updates could come very frequently or infrequently. In either case, if a user subscribes to a product, he or she receives all the updates until the subscription is canceled.

D.1.2.1.3 EIMC Sponsor - The EIMC may, in effect, become a user by sponsoring the broadcast of an information product upon request by the product source.

D.1.2.1.4 Activity Report - Report produced and broadcast by the JIMC, which is a summary of all broadcast activity during a specified period. The activity report can be used to compare products that were broadcast with products that were received in a user's JBS server.

D.1.2.1.5 Video Broadcast Guide - A schedule of what will be broadcast over JBS video channels. Analogous to the TV Guide.

D.1.3 Overall Philosophy

Policies and procedures in this annex will facilitate rapid transfer of information between the warfighter and information sources using the JBS broadcast in conjunction with existing networks. Policies and procedures outlined in this annex are embryonic and based upon unproved and untested concepts. The guiding principle is direct access by the user to needed information and very fast delivery of this information over a large capacity broadcast system. This principle reflects the asymmetrical nature of information requests: short requests for information answered by large files to fill the information need. Broadcast technology is well suited to meet this need and relieve congestion from existing two-way communications networks.

The warfighter will have access to more, potentially conflicting information, from a variety of sources. The challenge will be to develop policies and procedures based on emerging commercial information technologies that will provide a common picture of the battlefield without limiting access to such information. Command staffs and users must continually review and update these policies and procedures to reflect innovative ideas and lessons learned on how this information flow can be more flexible and responsive to meet the needs of the warfighter.

To meet this challenge, the EIMC will establish policies to process information requirements (such as an Information Annex to OPLANs), produce/package information products, and distribute information to the user. These policies do not replace established methods or circumvent command relationships. They set the stage for improving the efficiency of information flow to the warfighter.

The policy outlined in this annex is intended to support procedures that can eventually be automated. Again, the principle is for the user to go straight to the information and get it without complex intermediate steps. Although software is being developed and tested to meet this goal, it is not yet available. Interim procedures will be promulgated to facilitate system use until automation is fully developed to support the concept outlined in this annex.

D.1.3.1 Exploitation/Integration of New Technology

BC2A incorporates new commercial technology that can be exploited for military purposes. Among the potential uses are automated access and wide dissemination of near real time video and large data files. To fully exploit the technology advances in the BC2A, users must continue to develop and refine processes to take advantage of this technology. As the system develops, it's components must be integrated into the Defense Information Infrastructure (DII; e.g., GCCS, existing LANs, DISN, etc.) to expand benefits to a wider user community.

D.1.3.2 IM Responsiveness and Flexibility

Information management policy must be responsive to users needs. As new technology accelerates delivery and caching of information, IM procedures should provide value and not introduce unnecessary delays. The EIMC will work with all IM components to incorporate user feedback to improve system responsiveness and utility. To facilitate the responsiveness of BC2A, the EIMC will pursue the establishment of an Information Management Annex in each EUCOM Operation Plan (OPLAN) to identify required information to be broadcast to the theater upon execution of the OPLAN.

D.2. IM Components

Key BC2A components include:

- Users

- Site System Administrator (SSA) as appointed by users
- EUCOM Information Management Center (EIMC)
- Joint Information Management Center (JIMC)
- JBS Broadcast Management Center (BMC)
- Theater Injection Site (TIS)
- Information Sources/Production Sites

The EIMC, JIMC and BMC form the bridge between the operational users and the information sources. The primary components' roles are defined below.

D.2.1 Users

- look for required information on local systems, prior to requesting information from the JIMC. When the information is not held locally, users can search for required information from the catalog or any appropriate external source, using whatever means and/or network desired: SIPRNET, BC2A, Internet, or other network.

- Users are encouraged to request the JIMC add information that is found from other sources to the catalog.

- To get desired information from the JBS catalog, users first browse or search, using search tools provided with the catalog. The catalog and search tools will be broadcast periodically to all users so that they can search from their local server rather than across a network as INTELINK-S or Internet Web currently operates. The catalog entries will include meta data, which is information about the product being offered in the catalog. Users can review this meta data to find out if the product is suitable to meet their needs. If so, the users can click on the product icon and an order form will appear on the screen. To order the product users complete the order form and connect to the JIMC via SIPRNET. For users without SIPRNET access, the order form can be printed and faxed to the JIMC or the order can be given verbally over the telephone. Upon receipt of the order form, JIMC will retrieve, wrap, and transmit the product to the users.

- On the order form, users may request a one time delivery or a delivery with all updates (subscription) of the material.

- If a subscription is no longer needed, users must cancel the subscription.

- If the required information is not available locally, is not found on an external network or on the catalog, and JIMC cannot readily assist the user in locating the data, use the specific functional area request for information (RFI) process to locate the information. Users can identify to the functional manager that JBS is the desired transmission means.

- Sites should designate specific users who will be responsible for interacting with the JIMC in order to facilitate data requests, provide feedback to the JIMC/EIMC, and help minimize the administrative burden placed on the JIMC. Specific tasks include:

  - Provide input to JIMC/EIMC on products that should be included on the catalog

  - Identify video products desired and their sources

  - Develop and propose content for the information domain as an information source

  - Provide feedback to EIMC/JIMC/Sources on catalog entries.

D.2.1.1 Site System Administrator

A site system administrator will be required to perform certain technical duties associated with BC2A. Until automation and systems integration is developed to the point where users can get information from the BC2A directly to their work location, the SSA will need to assist in the information management process to ensure users get the information they need where they need it.

- Upon receipt of data at the JBS site, the SSA transfers data to local servers and LANs.

- Revises the server data lists to reflect receipt of data.

- Based upon local commander guidance, may forward data to specific local LAN users. Additionally, SSA may transfer the data to the media required by the user (such as, SIPRNET, FAX, tactical net).

- For further details on SSA duties, see the BC2A configuration management annex.

D.2.2 EUCOM Information Management Center

- Publishes and periodically (at least annually) updates policies and procedures, in coordination with the JIMC and the components, for information flow within the European theater.

- Determines the overall dissemination priority structure. Resolves theater conflicts for information and broadcast priority. Solicits feedback from users on effectiveness of priority. Makes policy for priority and provides feedback to users on priority.

- Reviews all requests for immediate and flash broadcast requests. This will be an after-the-fact review of precedence use. Provides feedback to users on suspected precedence inflation.

- Approves the JBS video broadcast schedule and channel allocations.

- Approves channel reallocation to support emergency broadcasts

- Reviews and validates subscriptions. This review and validation will be after-the-fact. Users may subscribe to products without EIMC approval. If a subscription is disapproved, EIMC will notify the user and JIMC to cancel the subscription.

- Coordinates with theater sources, components, and users to expand the BC2A catalog.

- Reviews system performance metrics to ensure system meets customer needs. Works with users, JIMC and BMC to improve information flow and procedures. Provides feedback to DISA for suspected/identified system deficiencies.

- Approves and "sponsors" information that, although not requested by specific users, sources want to be made available to theater users. EIMC will submit order form to JIMC for information it is "sponsoring."

- Defines and approves a standard order form for requesting data from the catalog. Defines and approves a standard format for meta data for catalog entries. Works with users, JIMC, and BC2A program office to develop a standard user interface.

- If a user or community of users require special assistance in getting information fast, the EIMC will validate this requirement and assist in the process. For example, if a combat search and rescue mission requires the normal broadcast schedule to be suspended, the EIMC (or ETCC after hours) will assist in "clearing the system" to facilitate operational high priority traffic.

- Establishes Memorandums of Agreement with theater sources to provide meta data for catalog and access to source data.

- Coordinates with JIMC as it develops MOAs with CONUS sources for accessing and controlling information retrieval and distribution.

D.2.3 Joint Information Management Center

- Ensures that no information is broadcast to theater that is not requested by a user or approved by EIMC (e.g. "sponsored" information). ETCC will be approval authority for after hours emergency broadcasts.

- Coordinates JBS broadcast with the Broadcast Management Center.

- Publishes and periodically updates an information product catalog as sources identify new information products and other sources are identified. Updates to the catalog will be based on input from the EIMC, EUCOM theater users, information sources, and other users.

- Develops links to sources (i.e. works with sources to make sure physical links exist). Prepares products for broadcast when requested by user (this process to be automated).

- Provides a catalog search engine to theater users.

- Works with EIMC and sources to standardize user interface.

- Conducts marketing with the sources to encourage them to populate catalog and support the program. Looks for data and video information on Intelink-S and other sources that may be useful and find ways to incorporate into BC2A.

- Maintains statistical information on system utilization. The JIMC will provide statistics to the EIMC on a regular basis.

- Develops, in coordination with the EIMC, MOAs with CONUS sources for accessing and controlling information retrieval and distribution.

- Assists user with accessing information. Responds to problems with catalog use. Provides the EIMC with updates on the status of user help requests. Keeps track of frequently asked questions and develops and promulgates lessons learned to users.

- Fills user information orders; both one time requests and subscriptions (i.e. one time broadcasts plus updates).

- Broadcasts recurring "activity reports" so users know what's been broadcast. Responds to user requests for activity reports for past periods to provide users visibility into system activity during periods of local outages.

- Works with sources and network managers to ensure compliance with security requirements relating to the dissemination of broadcast information.

- Maintains a capability to rebroadcast information as required by users. Rebroadcast of video is dependent upon availability of product from source.

- Works with BMC to acquire video broadcast licenses.

D.2.4 JBS Broadcast Management Center

- Generates and publishes the Video Broadcast Guide and disseminates it via the JBS to users.

- Broadcasts video and digital information provided to the uplink.

- Coordinates with commercial video sources to obtain licenses for JBS broadcast.

- Coordinates for delivery of video products from the source.

- Interfaces with all video sources for broadcast over the JBS.

- Maintains the JBS uplink and provides broadcast alert notices over video for system status, emergencies, weather bulletins, etc.

- Responds to EIMC via JIMC for request of special broadcasts.

- Collects network use and capacity statistics, and provides them to the JIMC.

D.2.5 Theater Injection Site

Equipment is installed at RAF Molesworth that is connected to the DISN LES at a 45 Mbps data rate. This equipment includes software capable of wrapping data files for direct injection into the JBS. This provides a virtual injection capability in theater. The future use of this capability will rely on software development to automatically wrap and transmit data that is transmitted to the TIS from theater sources. The JAC can use this capability today to wrap and inject their own products. It is not EUCOM's intention to place the burden of wrapping and injecting files from other data sources. Until the software can support this requirement, theater sources other than the JAC will have to transmit their products to the JIMC for broadcast.

- The Joint Analysis Center wraps and transmits intelligence data products produced by or stored at the JAC to the BMC for broadcast.

- The JAC must send a report to JIMC on products they transmit to ensure products injected from Molesworth are included in the activity report. This requirement must be automated as soon as possible.

- Provides injection of video products from theater (e.g., Predator)

- When system is automated, data from other theater sources can be routed through the theater injection computer to be wrapped and forwarded to the BMC for broadcast. This process must also include a notice to JIMC to ensure files injected will be included on the activity report.

D.2.6 Information Sources/Production Sites

Sources within and outside of theater should make their products available through the BC2A network. Specific user needs/requests may require sources to make available for broadcast such products as answers to requests for information, OPLANs, administrative publications, etc. Virtually all organizations to include users are a potential source of information (e.g., unit on-station reports)

- Supports information requests from the JIMC.

- Provides catalog meta data entries in format determined by EIMC. Ensures consistency of structure and format for each product or product update or ensures necessary changes are reflected in an update to the MOA.

- Develops MOAs with the JIMC or EIMC, as required, for providing catalog entries and transmitting products to the JIMC for wrapping and broadcast. Provides meta data, abstracts, key words, required applications and develops the data catalog in accordance with standard catalog format to assist users in accessing and using the information.

- Posts new and updated products in accordance with the MOA. Makes product updates available immediately.

- Are responsible for the release of their information.
- Ensures information products adhere to security specifications agreed to in the MOA and that all products are appropriately marked when viewed from the user's point of access.

3. Precedence

The BC2A provides large data pipes for rapid dissemination of video and large data files to all users. The approved precedence levels will be:

- Routine - normal mode of operation
- Immediate - for products needed immediately; requires minimum O-6 approval or approval by the senior watch/duty officer.

- Flash - for urgent requirements; requires minimum O-7 approval or approval by senior watch/duty officer.

For precedence to work, use of "immediate" and "flash" must be kept to a minimum to avoid precedence inflation. EIMC will review all precedence broadcasts and provide feedback to users on problems with precedence.

For contingency circumstances, the EIMC may suspend all precedence, and in extreme cases, scheduled broadcasts. In this case, authority for assigning precedence will rest with the EUCOM Crisis Action Team Battle Captain or the European Theater Command Center Command Director.

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